VISITOR EXPERIENCE AND RESOURCE PROTECTION

MONITORING PROGRAM FOR THE MERCED WILD AND SCENIC RIVER

ANNUAL MONITORING REPORT 2006

2006 ANNUAL MONITORING REPORT

VISITOR EXPERIENCE AND RESOURCE PROTECTION MONITORING PROGRAM FOR THE MERCED WILD AND SCENIC RIVER CORRIDOR

NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

Yosemite National Park
California

EXECUTIVE SUMMARY

2006 represented the third year of monitoring indicator variables related to visitor use and its impact within the Merced Wild and Scenic River corridor as part of the Visitor Experience and Resource Protection (VERP) program. This year, indicators and standards were improved upon; field monitoring and data collection was repeated building on operational efficiencies; and two workshops were held to evaluate and refine monitoring protocols and improve program administration.

A summary of results from indicator monitoring in 2006 are as follows:

- **Water Quality:** Monitoring efforts continued to build a rich dataset from which to establish baseline water quality conditions. Results from 2006 suggest a continuation of a high degree of water quality throughout the Merced corridor.
- **Extent of Social Trails:** In order to streamline data collection efforts and improve operational efficiencies a rotational sampling plan was initiated this year. A subset of meadows was monitored this year with rotations to occur on a bi-annual basis. Monitoring produced mixed results in 2006. For example, conditions in El Cap Meadow appear to have improved from 2005. Additional monitoring and analysis is recommended.
- **Wildlife Exposure to Human Food:** Monitoring procedures worked well and efficiently in 2006. Results from the field season suggest that food storage compliance rates at most major locations approached or exceeded the proposed standard. Minor changes to the database structure in 2007 will improve data reporting and analysis.
- **Riverbank Erosion:** This effort was significantly expanded in 2006 building upon the inventory of riverbank conditions conducted in 2005. Monitoring results have contributed to a broader understanding of the Merced River's morphology and corresponding erosion conditions. Continued monitoring and data analysis will be needed to determine the extent to which documented conditions were caused by visitor use.
- **Ethnobotany:** In the second year of this pilot indicator, data collection efforts focused on practitioner assessments, rather than a scientific inventory of plant conditions. Emphasis was placed on collaboration with local practitioners and limited data was collected in 2006. It was agreed, after the 2006 field season, to focus efforts on developing a GIS overlay with visitor use areas in the valley the following year. This would identify a larger number of sites to be assessed and time to foster cooperation with more practitioners, adding increased validity.
- **Wilderness Encounters:** Monitoring efforts for wilderness encounters were improved with more attention given to following established protocols. However, concerns over sample size remain. Results for three trail segments suggest periodic, but frequent encounters with more than one group per hour.
- **Parking Availability:** Increase training and attention to following a revised and expanded protocol marked the improvements for this indicator in 2006. Results, suggest that the day use parking area did not fill to capacity nearly as frequently as it did in 2005. Reasons for this may include more efficient parking due to direction from attendants, expanded parking footprint, and/or changes in vehicle composition at the site.
- **People At One Time (PAOT):** This protocol was significantly revised and expanded incorporating the facilities capacity indicator from 2005. PAOT counts were conducted at selected attraction sites, along the river, and along a segment of trail in the Merced River corridor. Results suggest sporadically high concentrations of use at the various monitoring locations.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES, CONTINUED

LIST OF TABLES

1. INTRODUCTION

2006 represents the third year of monitoring visitor use and its impact to the Merced Wild and Scenic River corridor (see Figure 1). This report presents field monitoring results and programmatic advancements of the Visitor Experience and Resource Protection (VERP) monitoring program. This program has continued to mature over the course of the past three years. Data collection efforts have been improved and made more efficient; the quality and rigor of the data have been tested; refinements have been made in the analysis and presentation of results; and programmatic efficiencies have been identified and expanded upon. The information collected in this report will be used by park managers, planners and the public alike to ensure that the quality of park resources and visitor experiences in Yosemite National Park are maintained.

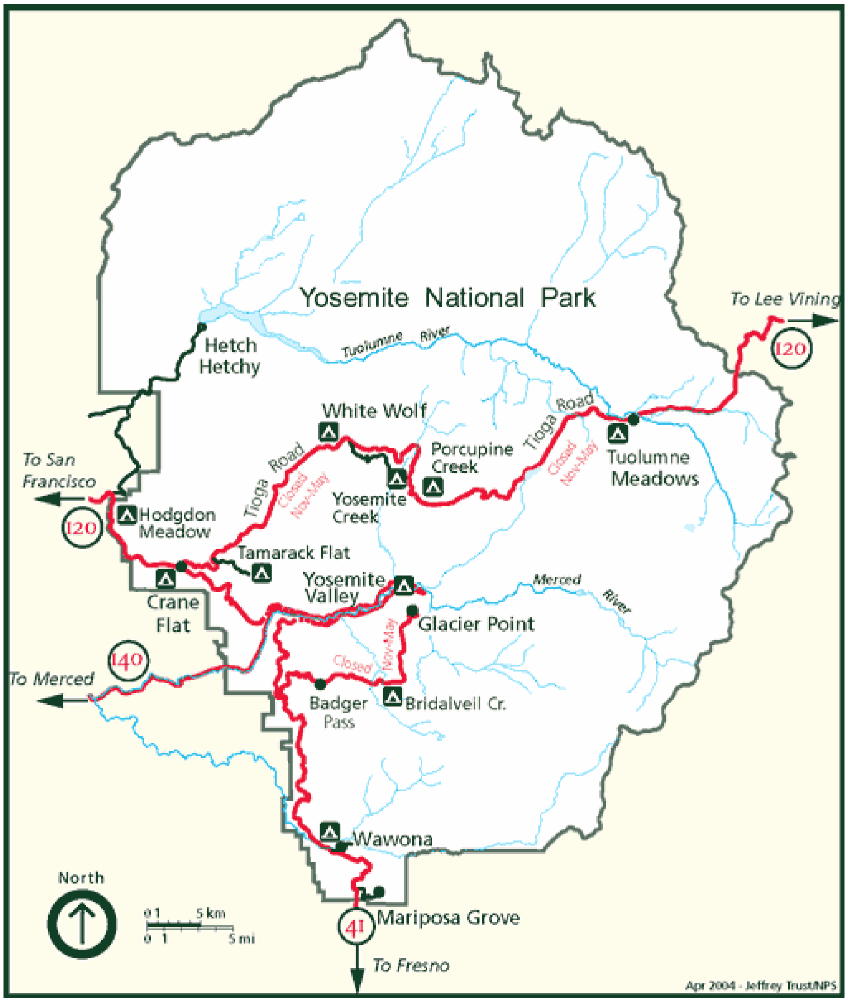


Figure 1. Map of Yosemite National Park.

1.1. BACKGROUND

The Organic Act established the National Park Service to, "conserve the scenery and the natural and historic objects and the wild life therein" while at the same time providing for "the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (NPS Organic Act 1916 - 16 USC 1). Thus, park planners and managers are charged to protect resources while providing for their enjoyment. How do we strike this balance?

VERP is a planning and management framework developed by the National Park Service to address human use and related issues in units of the National Park system (Hof et al. 1994, NPS 1995, NPS 1997). The VERP framework is an iterative process consisting of nine elements. These elements include both planning and management activities. Figure 1.2 below displays a summary of the framework. Fundamentally, the process consists of 1) defining desired conditions for park resources and human experiences, 2) developing indicators and standards of quality to monitor the condition of park resources and human experiences, and 3) taking management action to ensure desired conditions and experiences are maintained.

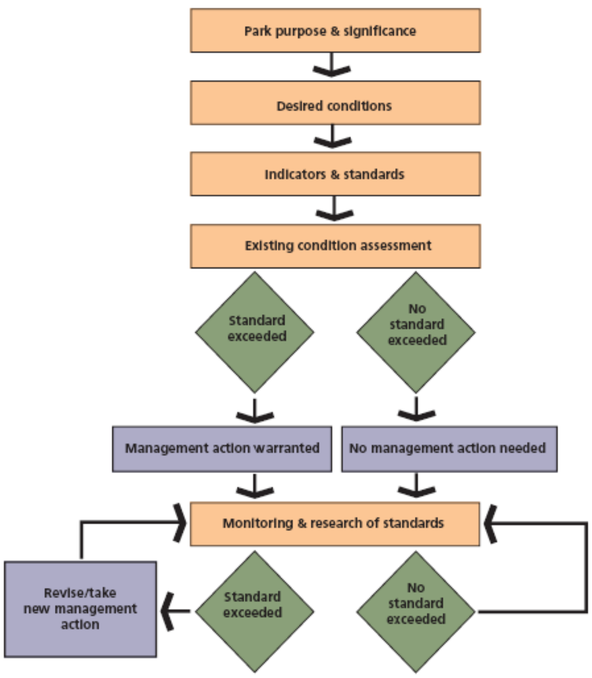


Figure 1.1. VERP Framework.

Indicators are measurable, manageable variables that reflect the condition of park resources and visitor experiences, while standards represent the desired condition of indicator variables (Manning 1999). Monitoring indicator variables provides important information to park planners and managers on the condition of park resources and human experiences (Hof and Lime 1997). Collectively, defining indicator variables, setting standards, and monitoring serve as an early warning system informing park managers of potentially unacceptable changes in resource and social conditions.

1.2. PROGRAM DEVELOPMENTS IN 2006

2006 marked the third year of the VERP monitoring program for the Merced Wild and Scenic River. Table 1.2.1 below presents a list of the indicators and standards for this year.

Table 1.2.1. Indicators and standards in 2006.

Indicators	Standards
Number of encounters with other parties in Wilderness	Zone 1A: No more than 1 encounter with another party per hour, 80% of the time. Zone 1B: No more than 1 encounters with another party per 4 hour period, 80% of the time.
Number of People At One Time (PAOT)	PAOT Trail: Nor more than 20 people at one time on a 50-meter section of trail, 80% of the time. PAOT River: To be determined. PAOT Attraction Sites: To be determined.
Occupied parking versus capacity	The number of instances (time) when designated parking is full (requiring alternative parking actions) will occur on no more than *X* days per year (season) and *X* hours on average/day (for visitors, transit buses, and commercial tour buses). (**NOTE:** ***X* represents the number of days and number of hours respectively. The standard is yet to be determined.**)
Wildlife exposure to human food	95% or greater compliance with food storage regulations in selected campgrounds and parking areas.
Social trails	No net increase in length from 2004 baseline.
Riverbank erosion	To be established.
Usability of traditionally gathered plants	To be established.
Water quality	Anti-degradation for each segment, for fecal coliform, nutrients (total nitrogen and total phosphorus), and petroleum hydrocarbons per sampling period. Absolute minimum, all segments: State fecal coliform standard for recreational contact at all times.

Some important changes were made to the VERP monitoring program in 2006. For example, in an effort to make the program more efficient and cost-effective, several indicators were consolidated. The facilities availability indicator was incorporated into the PAOT indicator and the number of social trails indicator was considered redundant to the length of social trails indicator.

The indicators presented above were monitored at a variety of locations representing the breadth of the management zones in the Merced River corridor. Figure 1.2.1 below shows the monitoring locations in the East Yosemite Valley only (a complete set of maps showing all sampling locations for each indicator variable is attached in Appendix A). Sampling locations were chosen to be representative of the various management zones, and/or to coincide with areas of resource or experiential concern.

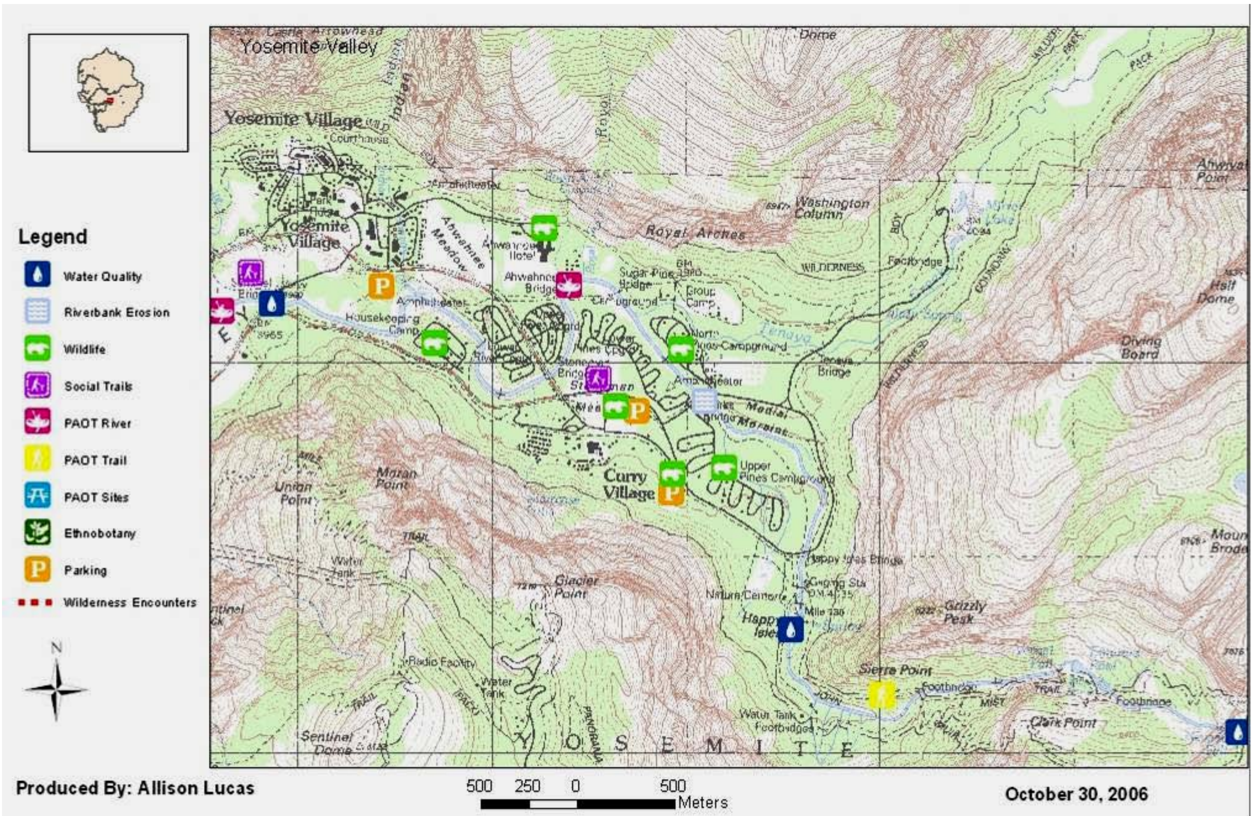


Figure 1.2.1. VERP Monitoring Locations in 2006.

Similar to previous years, the VERP monitoring program followed a timeline as represented in Figure 1.2.2 below. Generally, the late winter and early spring months were spent refining and improving monitoring protocols. In the spring preparations were made for data collection including hiring field staff, recruiting and organizing volunteers, preparing data sheets and finalizing protocols, checking and obtaining equipment, etc. The majority of data collection efforts took place during the summer and early fall. In the fall data were coded, analyzed and incorporated into a draft report. The annual report was finalized during the winter months concluding the program year.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Complete Annual Report from previous year											
		Refine monitoring protocols, prepare for new field season									
				Finalize Field Monitoring Guide, conduct field monitoring and collect data							
								Compile and analyze data, report writing, Fall workshop			
Progress report			Progress report			Progress report			Progress report		
Implement management actions throughout as stipulated in action plan											

Figure 1.2.2. VERP program timeline.

1.3. VISITOR USE IN 2006

Understanding that user capacity refers to the types and levels of visitor use that may appropriately be accommodated in a particular park unit, it is important to include in the beginning of this report a characterization of visitor use for 2006 as this may assist in understanding the results. Here we are concerned with providing a general overview of use levels and use behavior during the calendar year.

In 2006 Yosemite National Park received 3,359,385 recreation visits, including 1,568,625 overnight stays. Typically, visitors spent approximately 19 hours in the park during their visit. These use levels are similar to 2005 figures. Last year, the park received 3,527,216 recreation visits, including 1,558,515 overnight stays, a decrease of 4.8% overall (source: NPS Public Use Statistics Office).

The following series of tables presents visitor use statistics by entrance station for the peak use period from May to October 2006. The reader will note that no data was recorded for Tioga Pass in May as it did not open for the season until June. Also, traffic count estimates were not conducted for many of the entrance stations. In general, use peaked in August with 528,254 total recreation visits. Finally, readers should also note the significantly disproportionate number of visitors entering the Arch Rock entrance. This was most likely due to the closure of Highway 140 outside of the park due to the Fergusson rockslide. This closure remained in place from April until August.

Table 1.3.1. Visitor use statistics for peak season May to October 2006.

May 2006

	Estimated Traffic Count	Visits by Auto	Bus Visitors	Total Rec Visitors	Total Hours	Non-Rec Visitors	Non-Rec Hours	# of Buses
Arch Rock	0	1,848	1,927	3,775	18,874	85	2,658	126
South Entrance	0	148,099	20,542	168,641	843,204	8,414	250,497	620
Big Oak Flat	0	120,969	7,803	128,772	643,859	3,618	60,201	344
Tioga Pass	0	0	0	0	0	0	0	0
Hetch Hetchy	0	8,199	0	8,199	40,996	449	7,467	N/A
Totals	N/A	279,115	30,272	309,387	1,546,934	12,566	320,823	1,090

June 2006

	Estimated Traffic Count	Visits by Auto	Bus Visitors	Total Rec Visitors	Total Hours	Non-Rec Visitors	Non-Rec Hours	# of Buses
Arch Rock	0	-281	1,009	728	3,639	0	0	97
South Entrance	0	162,627	20,535	183,162	915,809	9,229	274,741	613
Big Oak Flat	0	141,056	8,074	149,130	745,652	4,217	70,170	382
Tioga Pass	14,300	39,733	447	40,180	200,900	0	0	27
Hetch Hetchy	0	9,772	0	9,772	48,860	535	8,899	N/A
Totals	N/A	352,907	30,065	382,972	1,914,860	13,981	353,811	1,119

(SOURCE: NPS PUBLIC USE STATISTICS OFFICE)

Table 1.3.1. Visitor use statistics for peak season May to October 2006, continued.

July 2006

	Estimated Traffic Count	Visits by Auto	Bus Visitors	Total Rec Visitors	Total Hours	Non-Rec Visitors	Non-Rec Hours	# of Buses
Arch Rock	0	-348	1,208	860	4,300	0	0	120
South Entrance	0	181,857	21,243	203,100	1,015,499	10,309	306,892	616
Big Oak Flat	0	160,044	7,117	167,161	835,805	4,792	79,747	525
Tioga Pass	29,450	129,730	3,208	132,938	664,689	1,381	22,983	112
Hetch Hetchy	0	6,874	0	6,874	34,369	377	6,260	N/A
Totals	N/A	478,156	32,776	510,932	2,554,662	16,859	415,882	1,373

August 2006

	Estimated Traffic Count	Visits by Auto	Bus Visitors	Total Rec Visitors	Total Hours	Non-Rec Visitors	Non-Rec Hours	# of Buses
Arch Rock	0	65,682	2,033	67,715	338,574	2,536	79,488	178
South Entrance	0	155,960	23,951	179,911	899,557	8,871	264,076	711
Big Oak Flat	0	147,125	8,070	155,195	775,974	4,397	73,165	382
Tioga Pass	0	114,960	4,518	119,478	597,391	3,317	55,197	164
Hetch Hetchy	0	5,955	0	5,955	29,776	326	5,423	N/A
Totals	N/A	489,682	38,572	528,254	2,641,271	19,447	477,350	1,435

September 2006

	Estimated Traffic Count	Visits by Auto	Bus Visitors	Total Rec Visitors	Total Hours	Non-Rec Visitors	Non-Rec Hours	# of Buses
Arch Rock	0	72,316	4,700	77,016	385,078	2,808	87,990	332
South Entrance	0	108,491	18,115	126,606	633,028	6,185	184,142	586
Big Oak Flat	0	103,326	11,394	114,720	573,599	3,101	51,601	420
Tioga Pass	0	93,752	4,546	98,298	491,489	2,708	45,053	162
Hetch Hetchy	0	4,863	0	4,863	24,314	266	4,428	N/A
Totals	N/A	382,747	38,755	421,502	2,107,508	15,068	373,215	1,500

October 2006

	Estimated Traffic Count	Visits by Auto	Bus Visitors	Total Rec Visitors	Total Hours	Non-Rec Visitors	Non-Rec Hours	# of Buses
Arch Rock	0	59,947	2,529	62,476	312,381	2,317	72,606	179
South Entrance	0	82,079	12,299	94,378	471,888	4,673	139,117	403
Big Oak Flat	0	76,529	11,008	87,537	437,685	2,300	38,276	351
Tioga Pass	0	50,437	1,430	51,867	259,335	1,454	24,192	54
Hetch Hetchy	0	2,513	0	2,513	12,564	138	2,288	N/A
Totals	N/A	271,505	27,266	298,771	1,493,853	10,882	276,479	987

1.4. COLLABORATION AND CONSULTATION

The VERP monitoring program relies on the efforts of a diversity of park staff, park partners, cooperating institutions, interns, volunteers and other members of the public. Without their integral time and energy, this program would not be possible.

The National Park Service worked with North Carolina State University and Colorado State University under cooperative agreements for technical expertise and academic support on monitoring protocol development and data analysis. Applying monitoring methods that have undergone academic rigor, the VERP monitoring program was able to make substantial progress in its iterative capacity.

A new program was piloted in 2006 where VERP monitoring program staff collaborated with the Yosemite Institute on a field ecology course (see Figure 1.4.1). This course included a component on recreation ecology and student participants worked with NPS staff to test and implement a formal trail monitoring protocol.

Figure 1.4.1. NPS staff working with Yosemite Institute staff and students in 2006.

The monitoring program also benefited in 2006 from the efforts of two Student Conservation Corps (SCA) volunteers. The SCAs provided important field and technical support for data collection and monitoring.

The ethnobotany work described in this report was the direct result of collaboration with members of the American Indian Council of Mariposa County and other American Indian tribal practitioners. This interaction was essential in understanding the importance and utility of various plant species in contemporary tribal activities. Practitioners also conducted field assessments at a variety of traditional gathering locations.

Finally, the VERP monitoring program counted on the invaluable efforts of more than 25 volunteers who contributed in myriad ways to this work in 2006 (see Figure 1.4.2).

Figure 1.4.2. NPS staff and volunteers have a pot-luck to celebrate the end of the field season.

This report is a testimony to the collective efforts of the above mentioned individuals and their contribution is greatly appreciated.

1.5. REPORT OVERVIEW

This Annual Report presents VERP monitoring program activities and data collection results for the 2006 calendar year. It is organized into the following sections: 1) Introduction, 2) Monitoring Results, 3) Program Evaluation, 4) Summary, and 5) Appendices. The reader will note that a section outlining the various methods used to collect and analyze data is absent from this report. This information is compiled in the 2006 VERP Field Monitoring Guide. This guide and other documents pertaining to the VERP monitoring program may be found on the park's website at: **www.nps.gov/yose/planning**. Data collected from the 2006 field season is available on request from the VERP Monitoring Program Coordinator, Bret Meldrum at bret_meldrum@nps.gov or (209)379-1216. In the coming years, data will be posted on the park website with appropriate metadata descriptions. Additional analysis of the VERP monitoring program datasets by other interested institutions and organizations is encouraged.

2. MONITORING RESULTS

This section presents the findings from indicator monitoring in 2006. Results are organized by indicator variable including the following information: indicator and standard description; indicator performance summary; monitoring activities; results; discussion; and management implications.

2.1. WATER QUALITY

Excellent water quality was identified by the Merced River Plan as part of the hydrologic processes Outstandingly Remarkable Value in three segments of the river corridor: in the wilderness reaches of the main stem and South Fork, as well as in the impoundment segment of the South Fork (above Wawona).

Water quality sampling on the Merced River initiated in June 2004 continues and results through October 2006 are incorporated into this report. Nutrient concentrations were generally quite low, often below the reporting limit for the analytical method. Table 2.1.1 summarizes the analytical methods used, reporting limits, and any applicable standards. For comparison purposes, the highest values of Nitrate + Nitrite, sampled at Foresta Bridge in El Portal, contained between 0.58 and 0.71 mg/l.

Table 2.1.1. Water quality constituents sampled in 2006.

Constituent	Analytical Method	Analytical Reporting Limit	California Standard	Source Document
Total Dissolved Nitrogen	USGS/NWQL[1] 2754	0.06 mg/l	None	
Nitrate + Nitrite	USGS/NWQL[1] 1979	0.016 mg/l	10 mg/l (Drinking water)	State of California Regulations, Title 22 – Drinking water standards, Maximum Contaminant Levels - Inorganic Chemicals
Total Phosphorous	USGS/NWQL[1] 2333	0.004 mg/l	None	
Total Dissolved Phosphorous	USGS/NWQL[1] 2331	0.004 mg/l	None	
E. coli	SM 9221F[2]	2 MPN/100ml (MPN = Mean Probable Number of bacterial colonies)	Geometric Mean of 5 samples taken over a 30-day period shall not exceed 126 MPN/100 ml. No single sample shall exceed 235 MPN/100 ml.	State of California, 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region. Fourth Edition—1998. California Regional Water Quality Control Board.
Total Petroleum Hydrocarbons	EPA 306M[3]	13 µg/l	Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.	State of California, 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region. Fourth Edition—1998. California Regional Water Quality Control Board.

[1] U.S. Geological Survey National Water Quality Laboratory
[2] Standard Methods for the Examination of Water and Wastewater
[3] Environmental Protection Agency Standard Method

Measurement: The following water quality parameters were measured: Nutrients (total dissolved nitrogen, nitrate + nitrite, total phosphorous, and total dissolved phosphorous), *E. coli*, and total petroleum hydrocarbons. Associated field data collected with each water quality sample included water temperature, specific conductivity, dissolved oxygen, and pH.

Standards: Anti-degradation for each segment for fecal coliform (*E. coli*), nutrients (total dissolved nitrogen, nitrate + nitrite, total dissolved phosphorous, and total phosphorus), and total petroleum hydrocarbons per sampling period. Absolute minimum, all segments: State *E. coli* standard for recreational contact at all times.

Zones:

- 1D Designated Overnight
- 2A Open Space
- 2C Day Use
- 2D Attraction
- 3A Camping
- 3B Visitor Base and Lodging
- 3C Park Operations and Administration

Sampling: Field staff sampled at ten locations monthly on the Merced River and South Fork (Figure 2.1.1) in coordination with state-mandated water quality sampling conducted by Park utilities personnel at the waste water treatment plants in Wawona and El Portal. In addition, several storm events where sampled including spring run-off. The latter was conducted weekly for a period of ten weeks. Nutrients (total dissolved nitrogen, nitrate, total phosphorous and total dissolved phosphorous) were sampled at all sites. *E. coli* was sampled only at front-country sites due to the maximum six-hour hold time for these samples. Total petroleum hydrocarbons were sampled at three locations downstream of developed areas. In addition to collecting samples, field staff measured water temperature, specific conductivity, pH, and dissolved oxygen as well as river stage where possible.

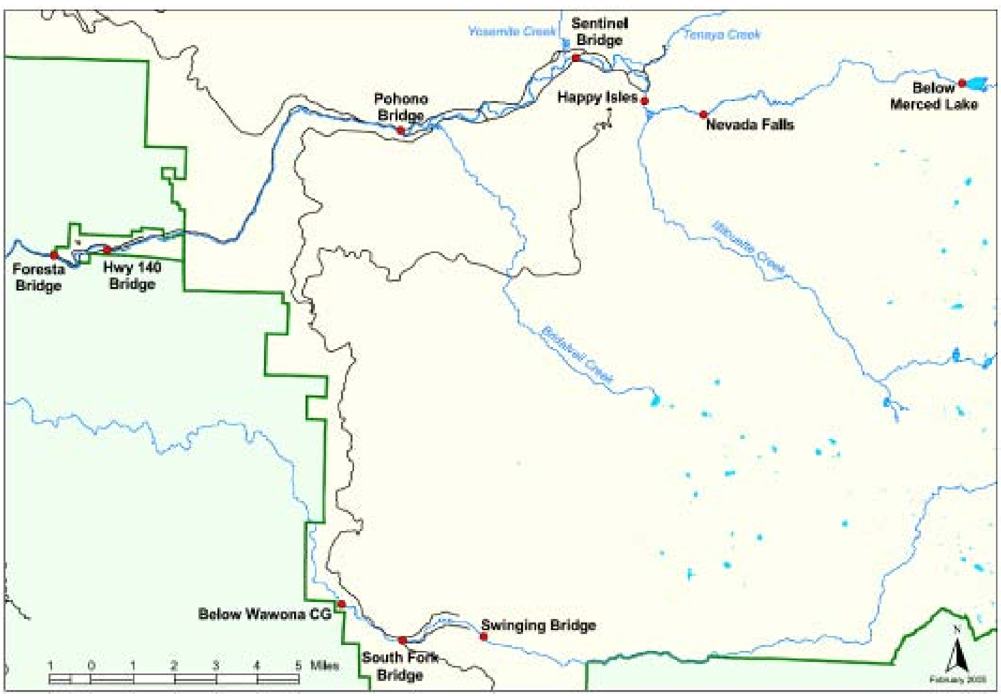


Figure 2.1.1. Merced River water quality sampling locations.

Results: Nutrient data are summarized in the following time series plots, Figures 2.1.2.a-j, for the eight Merced River sites for the entire collection period (June 2004 – October 2006). All concentrations continue to be very low indicating excellent water quality. Relatively elevated levels of total dissolved nitrogen (TDN) and nitrate plus nitrite (NO3+NO2) are evident during winter 2005-2006, perhaps the result of many warm (wet) winter storms. The highest values of TDN and NO3+NO2 observed during the reporting period (November 2005 – October 2006) were 0.482 and 0.456 mg/l respectively found at Foresta Bridge on October 4, 2006.

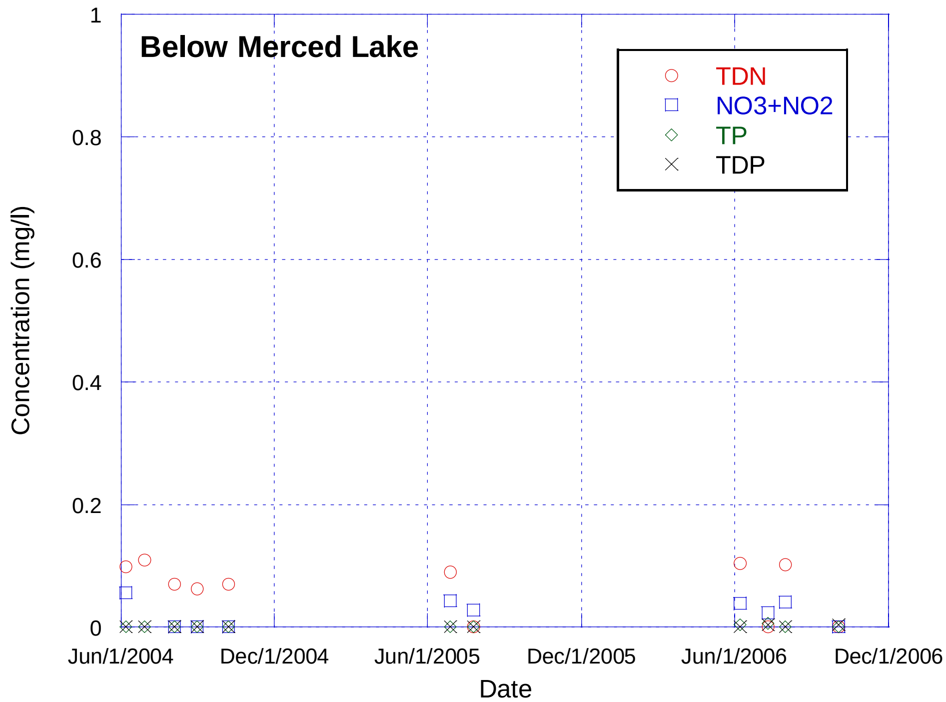


Figure 2.1.2.a. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

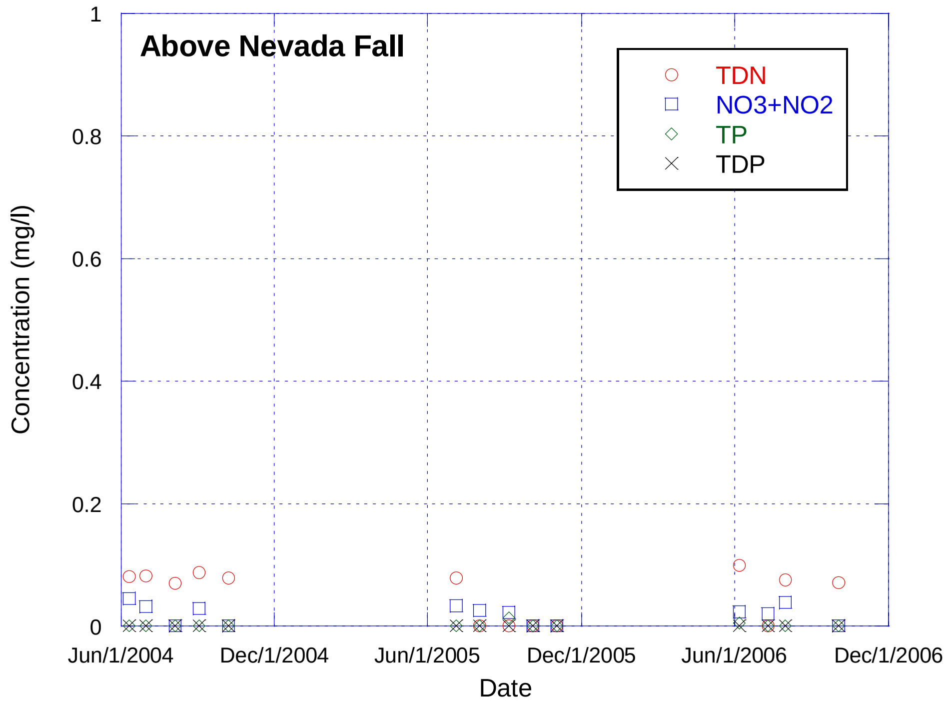


Figure 2.1.2.b. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

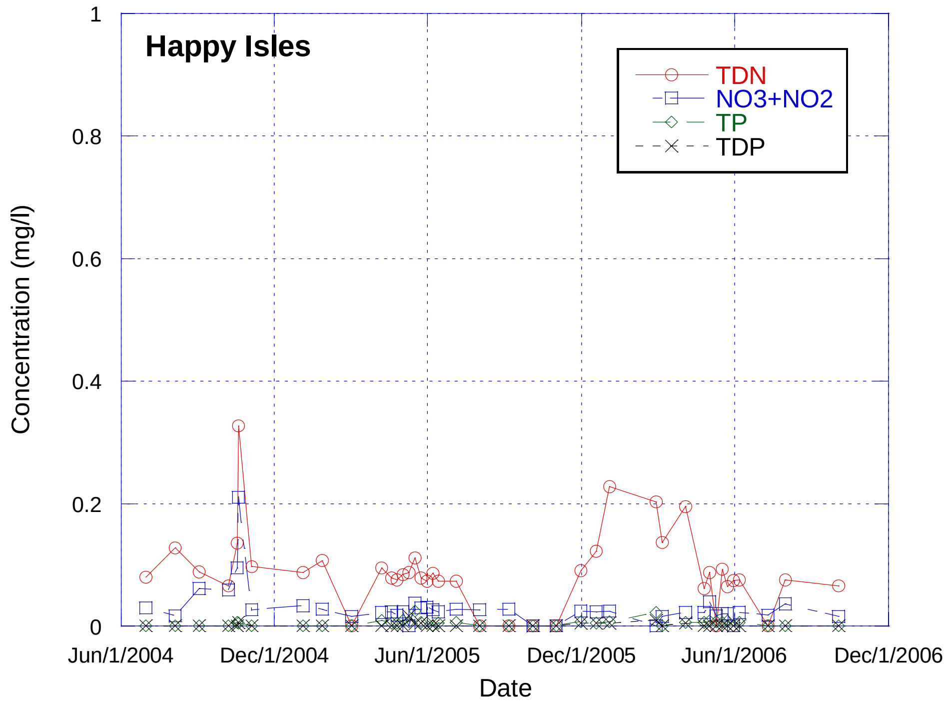


Figure 2.1.2.c. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

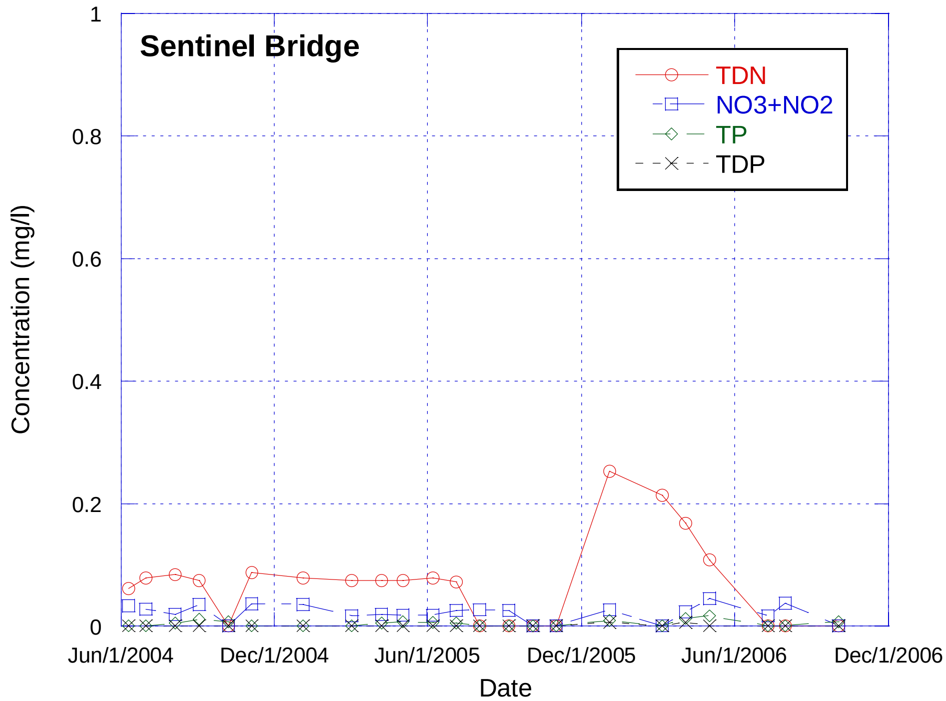


Figure 2.1.2.d. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

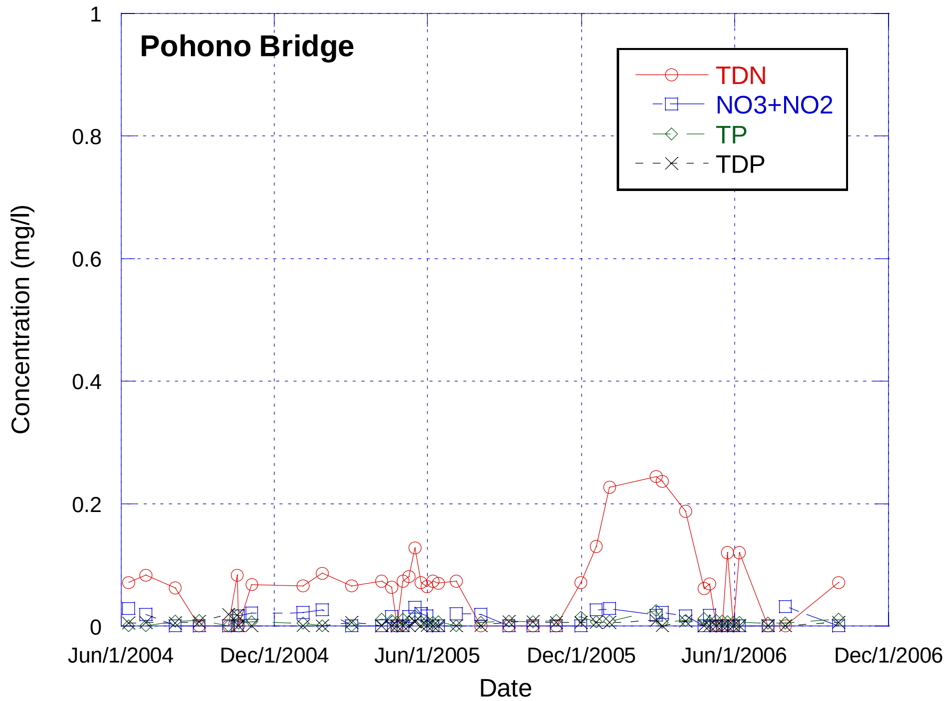


Figure 2.1.2.e. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

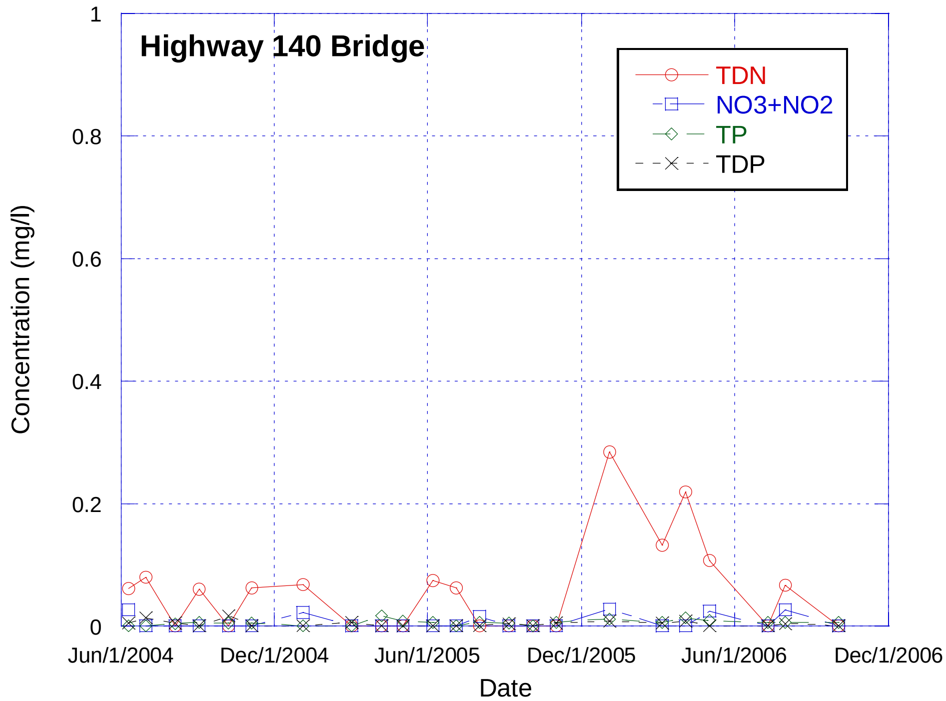


Figure 2.1.2.f. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

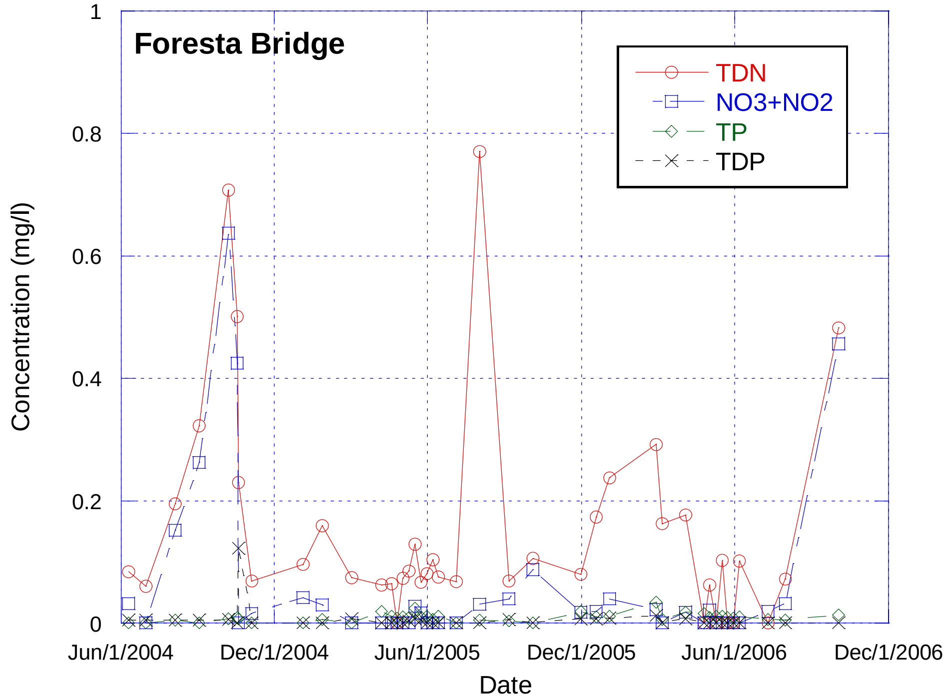


Figure 2.1.2.g. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

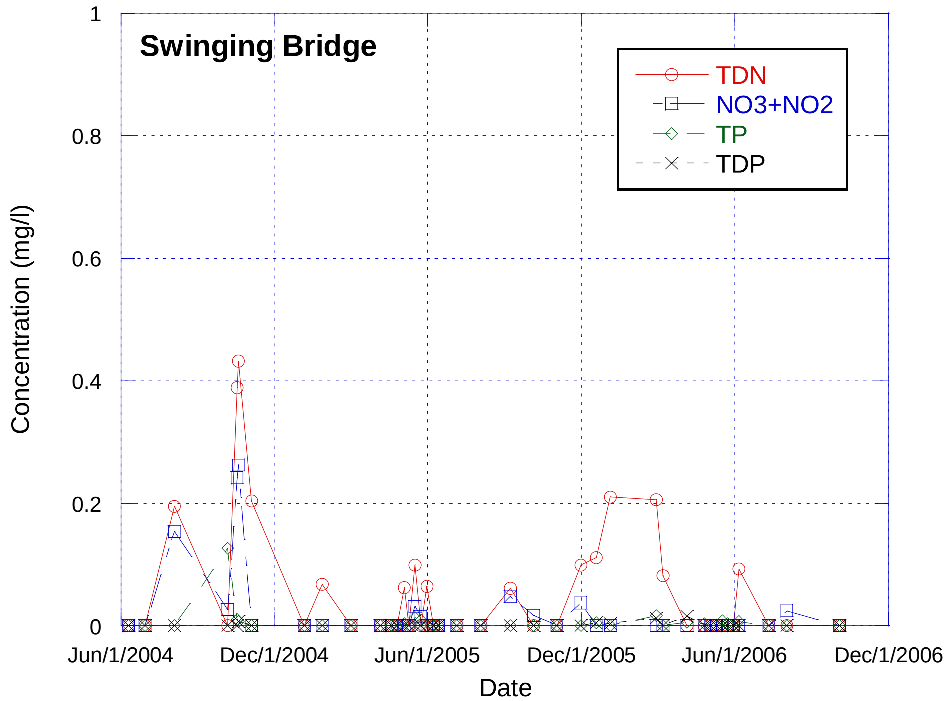


Figure 2.1.2.h. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

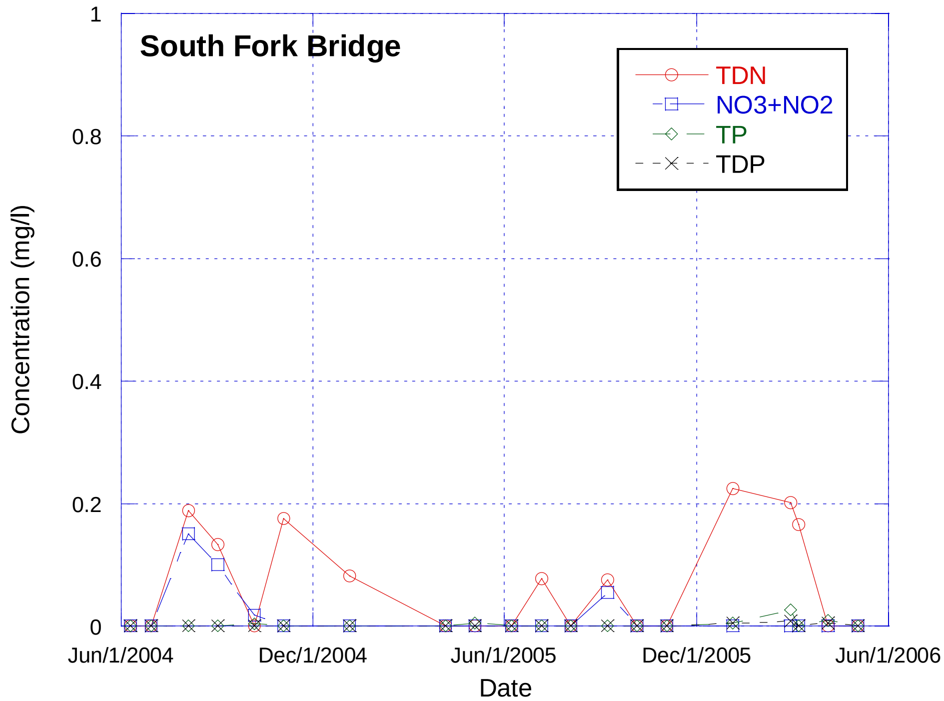


Figure 2.1.2.i. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

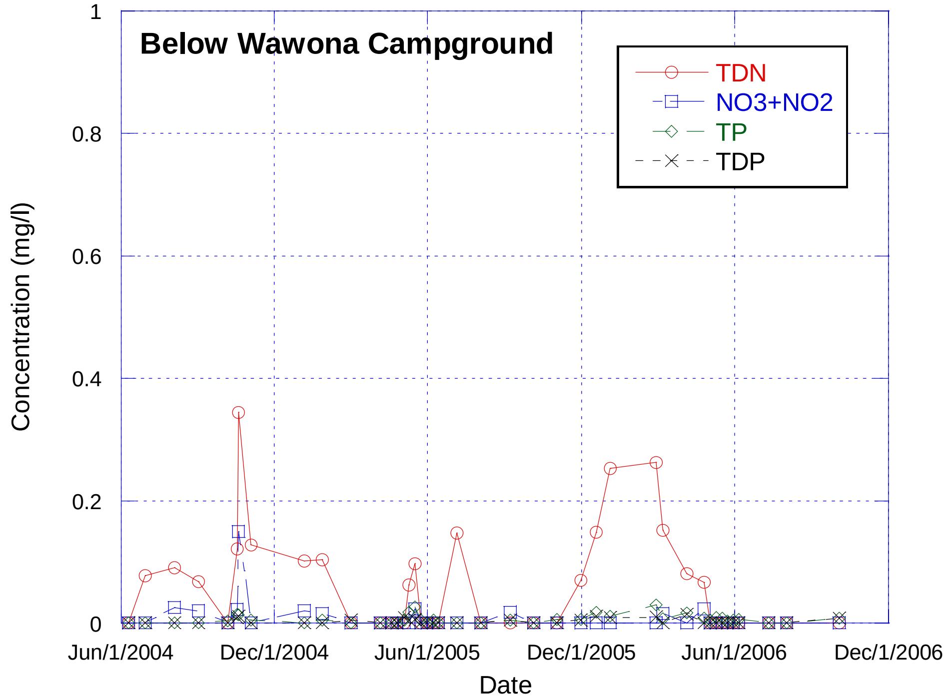


Figure 2.1.2.j. Summary Nutrient Data (June 2004 – October 2006). Gaps indicate periods of no data collection. Non-detectable concentrations have been assigned a value of zero. TDN = Total Dissolved Nitrogen, NO3 + NO2 = Nitrate plus Nitrite, TP = Total Phosphorous, TDP = Total Dissolved Phosphorous.

Bacterial content (*E. coli*) has been measured since April 2005. Table 2.1.2 summarizes *E. coli* concentrations measured from November 2005 to October 2006 (previous data is summarized in the 2005 VERP Annual Report). *E. coli* concentrations continue to be very low with 82% of samples in the <1 to 10 MPN/100ml range. No single sample exceeded the state standard for recreational contact of 235 MPN/100ml.

Table 2.1.2.Summary of *E. coli* data, November 2005 to October 2006.

Site Name	Date	*E. coli* (MPN/100ml)*
Merced River above Happy Isles Bridge	1-Nov-05	<1
	30-Nov-05	54
	19-Dec-05	6
	3-Jan-06	20.3
	28-Feb-06	22
	7-Mar-06	14
	26-Apr-06	1
	2-May-06	7.5
	10-May-06	1
	17-May-06	1
	24-May-06	1
	31-May-06	2
	11-Jul-06	3
	1-Aug-06	5.2
	3-Oct-06	1
Merced River above Sentinel Bridge	1-Nov-05	2
	7-Mar-06	5
	2-May-06	7.5
	11-Jul-06	8.6
	1-Aug-06	4.1
	3-Oct-06	7.3
Merced River above Pohono Bridge	1-Nov-05	2
	30-Nov-05	33
	19-Dec-05	10
	3-Jan-06	7
	28-Feb-06	10
	7-Mar-06	5
	26-Apr-06	<1
	2-May-06	3.1
	10-May-06	5.2
	24-May-06	<1
	31-May-06	3
	11-Jul-06	8.6
	1-Aug-06	16
	3-Oct-06	4.1
Merced River above SR140 Bridge	1-Nov-05	2
	3-Jan-06	2
	7-Mar-06	8

Site Name	Date	*E. coli* (MPN/100ml)*
	2-May-06	6.3
	11-Jul-06	7.4
	1-Aug-06	2
	3-Oct-06	2
Merced River above Foresta Bridge	30-Nov-05	29
	19-Dec-05	8
	3-Jan-06	2
	28-Feb-06	24
	7-Mar-06	7
	26-Apr-06	5.2
	2-May-06	4.1
	10-May-06	3.1
	17-May-06	6.3
	24-May-06	1
	31-May-06	1
	11-Jul-06	9.7
	1-Aug-06	3.1
	3-Oct-06	2
S. Fork Merced River above Swinging Bridge	2-Nov-05	2
	30-Nov-05	46
	19-Dec-05	23
	4-Jan-06	10.9
	28-Feb-06	5
	8-Mar-06	3
	26-Apr-06	2
	3-May-06	<1
	10-May-06	<1
	17-May-06	<1
	24-May-06	1
	31-May-06	1
	6-Jun-06	<1
	12-Jul-06	3.1
	2-Aug-06	5.2
	4-Oct-06	1
S. Fork Merced River above South Fork Bridge	2-Nov-05	1
	4-Jan-06	5
	28-Feb-06	8
	8-Mar-06	3
	3-May-06	1
	6-Jun-06	<1
	12-Jul-06	2
	2-Aug-06	3.1
	4-Oct-06	9.7
S. Fork Merced River below Wawona Campground	2-Nov-05	2
	30-Nov-05	26

Site Name	Date	*E. coli* (MPN/100ml)*
	19-Dec-05	27
	4-Jan-06	7.5
	28-Feb-06	12
	8-Mar-06	1
	26-Apr-06	17.5
	3-May-06	<1
	10-May-06	<1
	17-May-06	3.1
	24-May-06	1
	31-May-06	3
	6-Jun-06	1
	12-Jul-06	4.1
	2-Aug-06	4.1
	4-Oct-06	6.3

No petroleum hydrocarbons were detected during the sampling period from November 2005 to October 2006. Earlier data is contained in the 2005 VERP Annual Report. Sample frequency has been reduced to quarterly sampling. Storm events continue to be sampled and sampling is conducted monthly during spring runoff.

Discussion: As of the completion of this reporting period (November 2005 – October 2006), approximately 75% of sampling necessary to establish baseline conditions on the Merced River and the South Fork of the Merced has been completed. Data presented in this report will be used to construct water quality standards when the sample size for each location and constituent is sufficient to be statistically robust. In 2007, particular emphasis should be made on a comprehensive data review and statistical analysis to determine the quality of baseline data with respect to the establishment of a standard as well as determining a future sampling strategy to assure compliance with a given standard.

Nutrient concentrations at all sample sites were low, even during low water, storm, and spring runoff conditions. Sampling frequency may be decreased, particularly for phosphorous species in order to examine other aspects of water quality impacted by human activity such as turbidity.

E. coli concentrations were quite low during the reporting period. Sampling of this constituent will continue at the present frequency.

Sampling for petroleum hydrocarbons revealed no reportable amounts in all sampling for the reporting period. Given that small amounts were detected in the 2005 field season, sampling will continue, though at a reduced frequency with particular emphasis on capturing storm events.

All data to date indicate very good water quality along the main stem and South Fork of the Merced River. Funds secured through a cooperative USGS/NPS grant will continue to allow further characterization of water quality such as measuring turbidity and automated sampling of storm events. The latter will allow sampling as the river rises during a storm, the period often associated with the highest nutrient concentrations. (At present, logistical considerations often limit sampling to the period after a storm as the river levels fall.) Remaining baseline sampling along with these additional investigations will permit establishment of sound water quality standards for the future.

2.2. EXTENT OF SOCIAL TRAILS

Meadows are delicate natural resources that contribute significantly to the ecology of Yosemite Valley. They also engender the Valley with a unique pastoral aspect conducive to the enjoyment of recreation and leisure activities. However, human use in meadows can cause adverse impacts including vegetation loss, introduction of exotic flora, soil compaction and loss, and other effects. Often these impacts are a result of social trail proliferation. As people walk out into the meadow to engage in various activities (e.g. picnicking, nature and wildlife viewing, photography, etc.), they can leave behind an informal network of trails. These trails may negatively impact the integrity of the meadow ecosystem (Holmquist and Schmidt-Gengenbach 2003) as well as the quality of the visitor experience (Manning et al. 2005).

The extent and condition of informal trails is indicative of the contiguity and ecological health of meadows and wetland areas - reflecting part of the biological Outstandingly Remarkable Values of the Merced and Tuolumne River corridors. It is also indicative of impacts to wildlife habitat, including special-status species (biological Outstandingly Remarkable Value). Archeological sites and traditional gathering areas used by American Indian groups exist in some meadows, and could be affected by the proliferation and length of informal trails in meadows (cultural Outstandingly Remarkable Values). The proliferation of informal trails in meadows may affect visitor experience, as meadows are enjoyable areas in which to engage in a variety of river-related recreational opportunities—including nature study, photography, etc. (recreation Outstandingly Remarkable Value), and informal trails may impact the scenic interface of river, rock, meadow, and forest. In this manner, monitoring the length of informal trails in meadows also contributes to the protection and enhancement of the scenic Outstandingly Remarkable Value of the river corridor.

Measurement: Extent (density) and condition of informal trails in the meadows of Yosemite Valley.

Standard: No net increase in density of informal trails when compared with baseline. Baseline inventory established in 2004 and 2005. Baseline will be updated as restoration actions are implemented and data is re-collected to reflect restoration efforts. In addition, a range of density threshold values of disturbed areas and trailing will be developed through consultation with professionals specializing in recreation and meadow ecology. The resulting standard will be developed through a combined effort from scientists and park management/planning specialists and will be based on desired conditions associated with particular management zones designed to protect Wild and Scenic River ORV's.

Zone(s): 2B Discovery, 2C Day Use

Sampling: A Global Positioning System (GPS)-based inventory of informal trails in the meadows of Yosemite Valley was initiated in 2004. Monitoring was repeated in 2005 to verify results and explore potential factors that could cause variation in collected data (e.g. monitoring post-deer rut, which potentially skewed results; weather variability influencing soil moisture and trailing patterns, etc.). In 2006, monitoring in the Valley was focused on the meadows that exhibited an increase in non-formal trail length between 2004 and 2005 to investigate trends in trail development. Wosky Pond meadow was randomly chosen for 2006 monitoring in addition to the aforementioned meadows to initiate the long-term monitoring project that will focus on detecting proliferation of informal trails.

Results: Figures 2.2.1 through 2.2.4 depict informal trails observed through GPS inventory in El Capitan, Cooks, Wosky Pond, and Stoneman meadows in 2006.

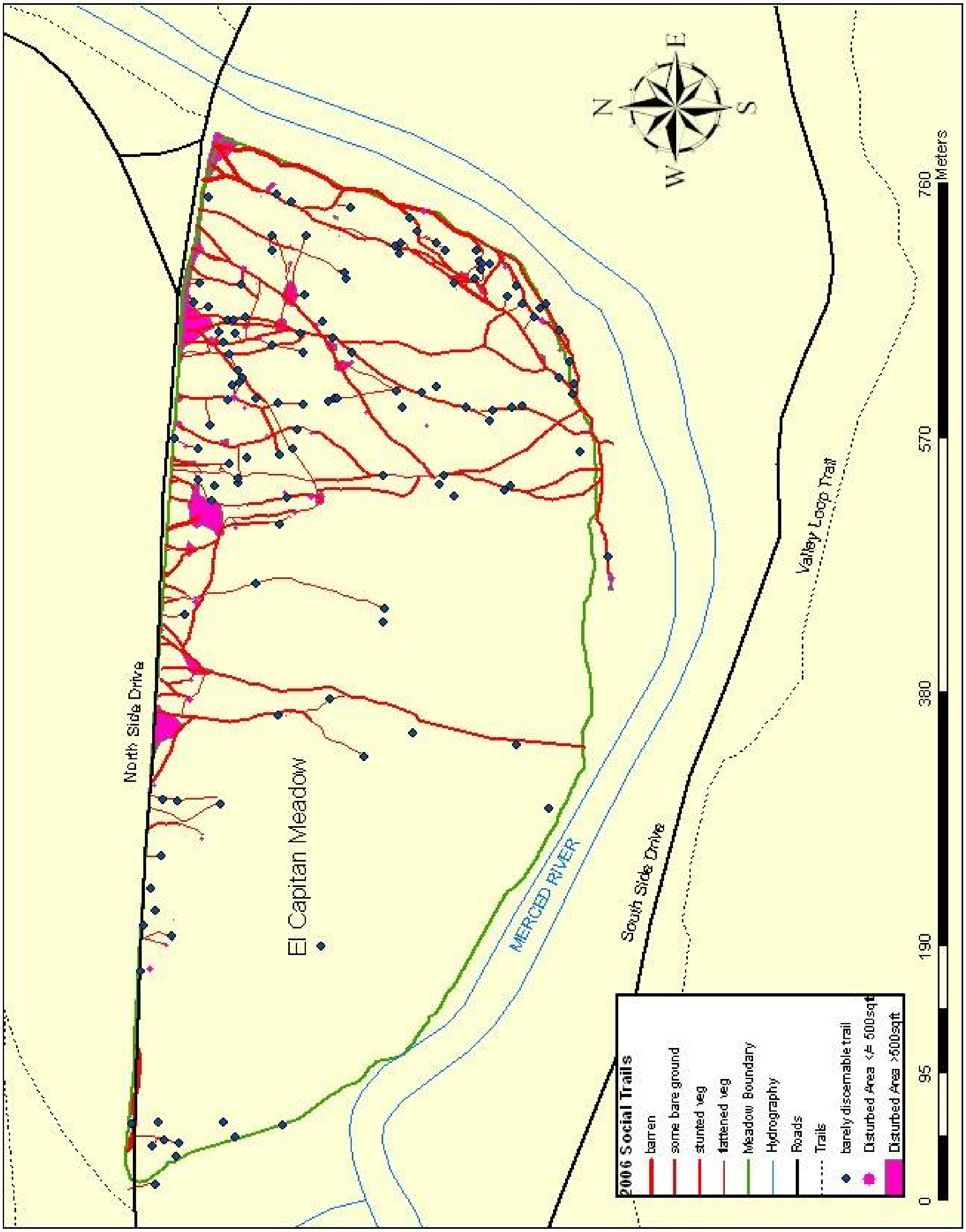


Figure 2.2.1. Extent of informal trails and disturbed areas in El Capitan meadow in 2006.

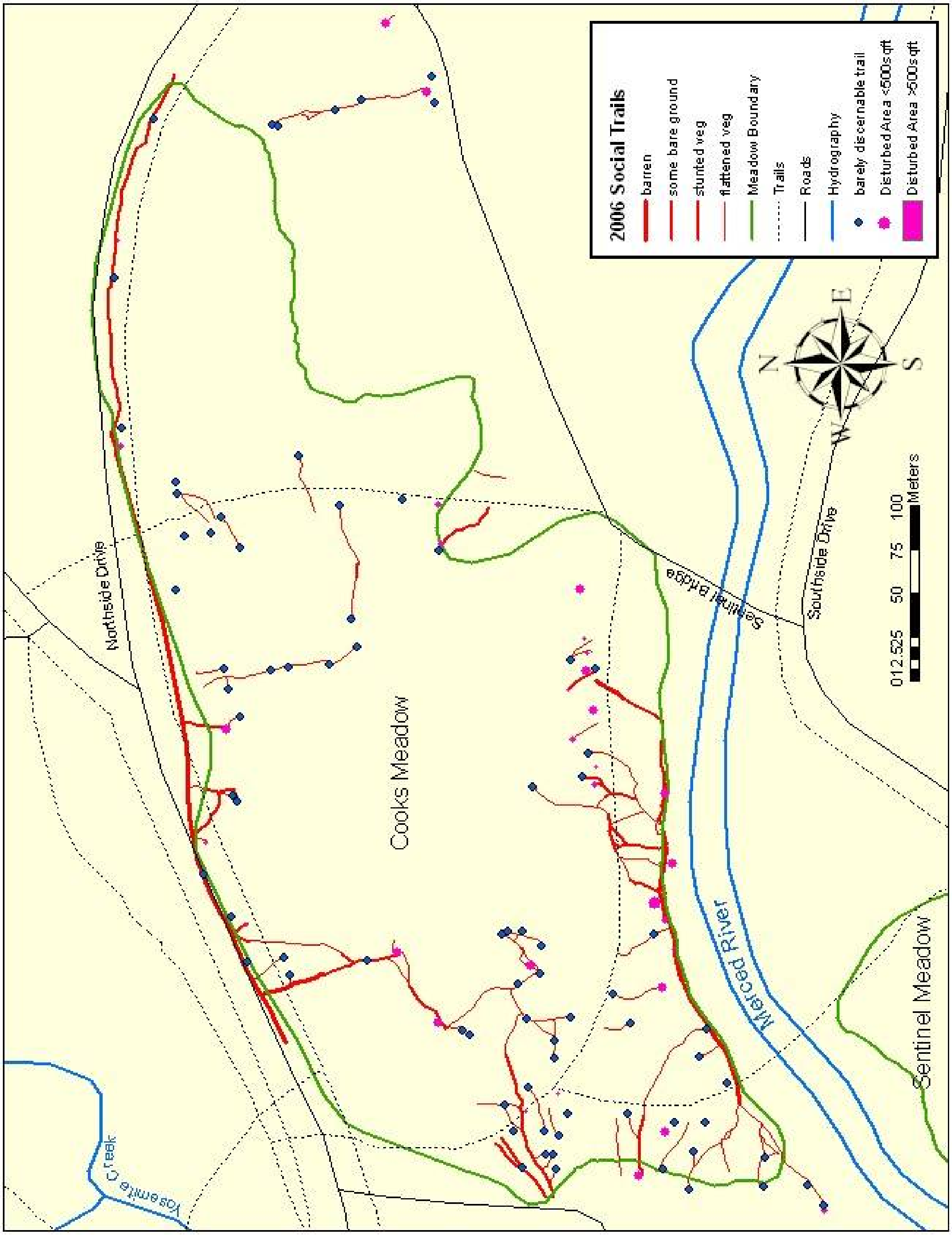


Figure 2.2.2. Extent of informal trails and disturbed areas in Cooks meadow in 2006.

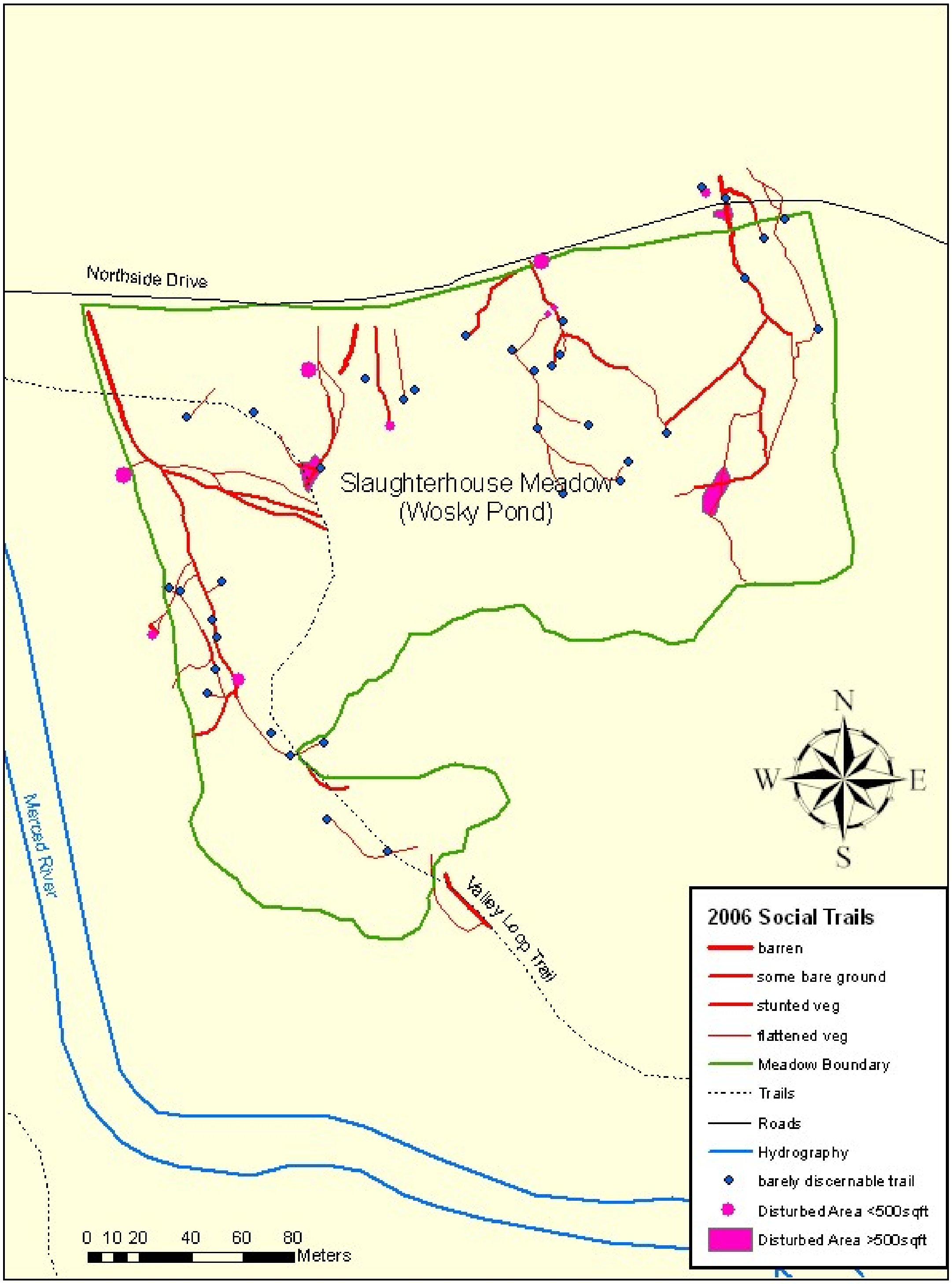


Figure 2.2.3. Extent of informal trails and disturbed areas in Wosky Pond meadow in 2006.

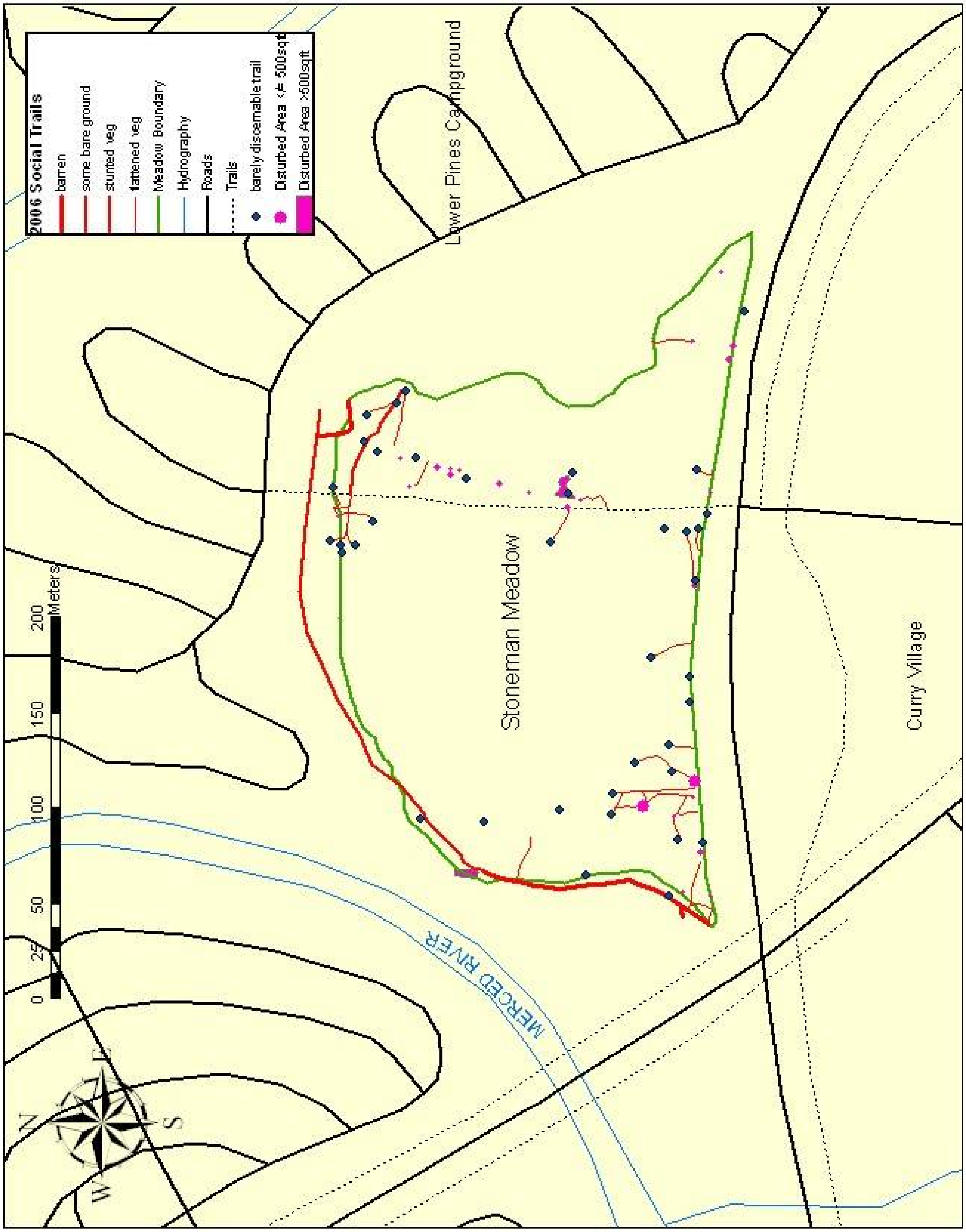
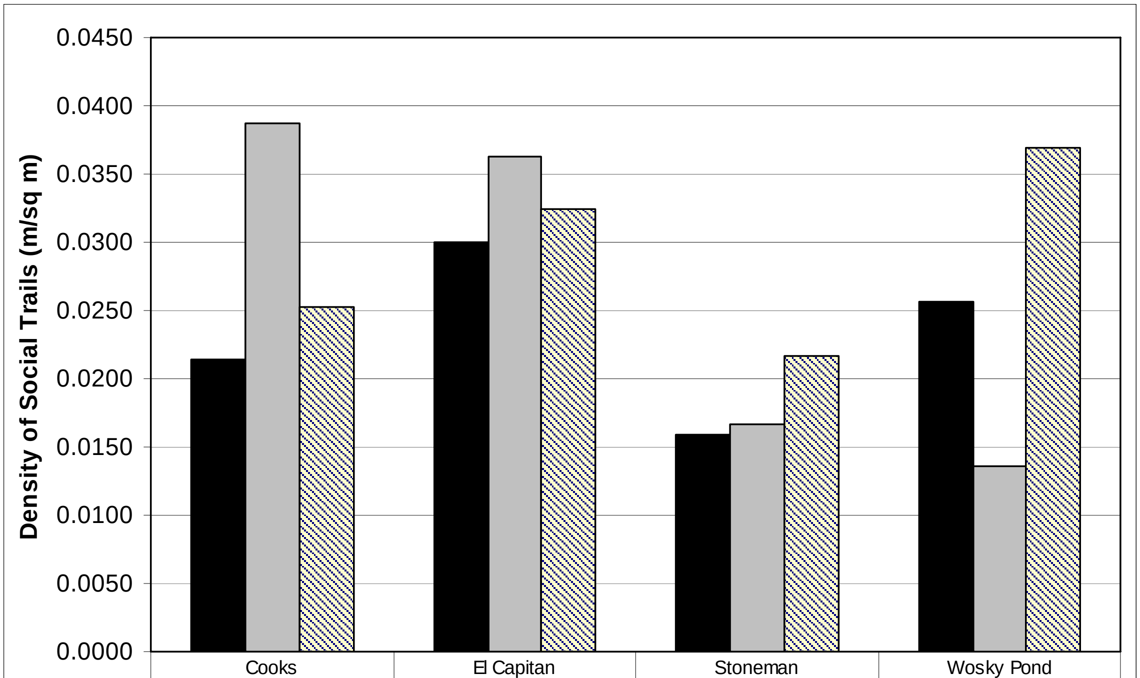


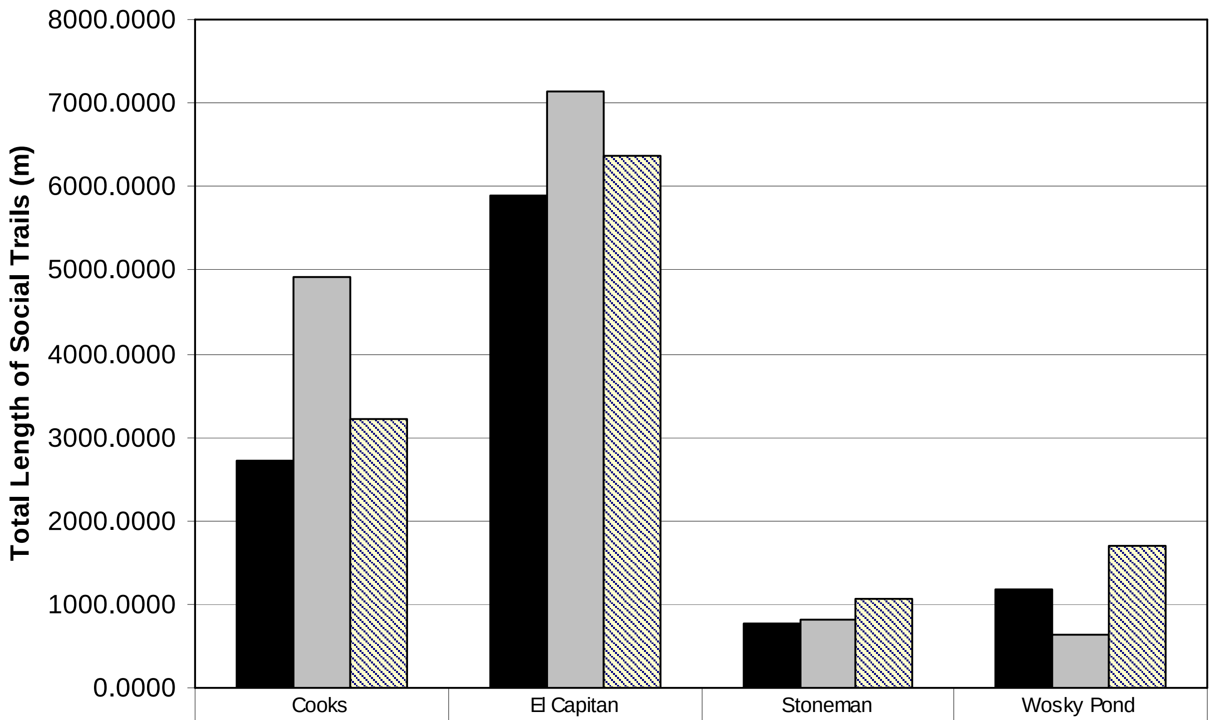
Figure 2.2.4. Extent of informal trails and disturbed areas in Stoneman meadow in 2006.

The non-formal trail density in meadows monitored in 2006 exhibited changes when compared to monitoring results from previous years (Figure 2.2.5). El Capitan meadow showed a decrease of 0.0039 m/m², Cooks meadow showed a decrease of 0.0134 m/m², Wosky Pond meadow showed an increase of 0.0604 m/m², and Stoneman meadow showed an increase of 0.0051 m/m². This large variation in density among years in any given meadow is discussed below. Figure 2.2.6 was included to provide perspective on density data relative to changes in linear extent of social trails. In concurrence with 2004 and 2005 data, El Capitan meadow exhibited the greatest length of social trails, with about half of that amount observed in Cooks meadow. Comparably, fewer informal trails were observed in Wosky Pond and Stoneman meadows.



	Cooks	El Capitan	Stoneman	Wosky Pond
2004	0.0214	0.0299	0.0159	0.0256
2005	0.0387	0.0363	0.0166	0.0136
2006	0.0253	0.0324	0.0217	0.0370

Figure 2.2.5. Density of social trails observed in Yosemite Valley meadows monitored in 2006.

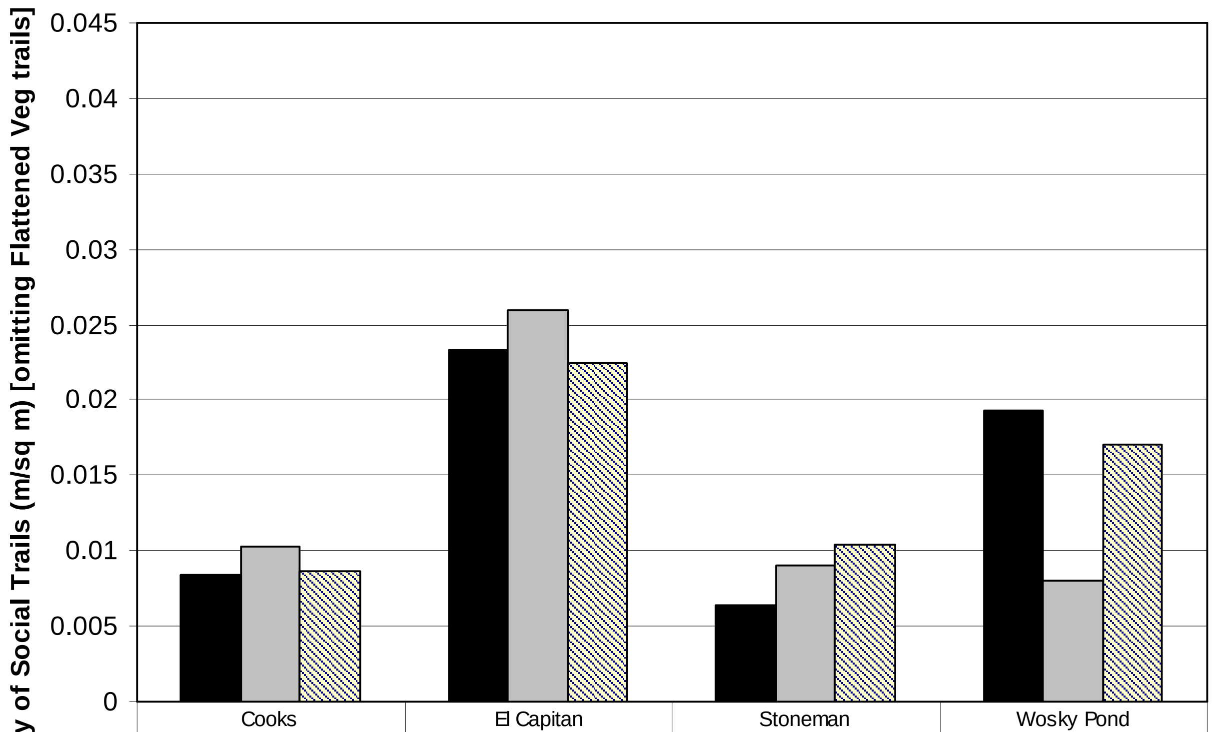


	Cooks	El Capitan	Stoneman	Wosky Pond
2004	2717.9000	5881.3000	774.5000	1181.8000
2005	4919.7000	7132.5000	807.8000	628.2000
2006	3211.4300	6357.7100	1056.4200	1706.1100

Figure 2.2.6. Total length of informal trails observed in Yosemite Valley meadows in 2006.

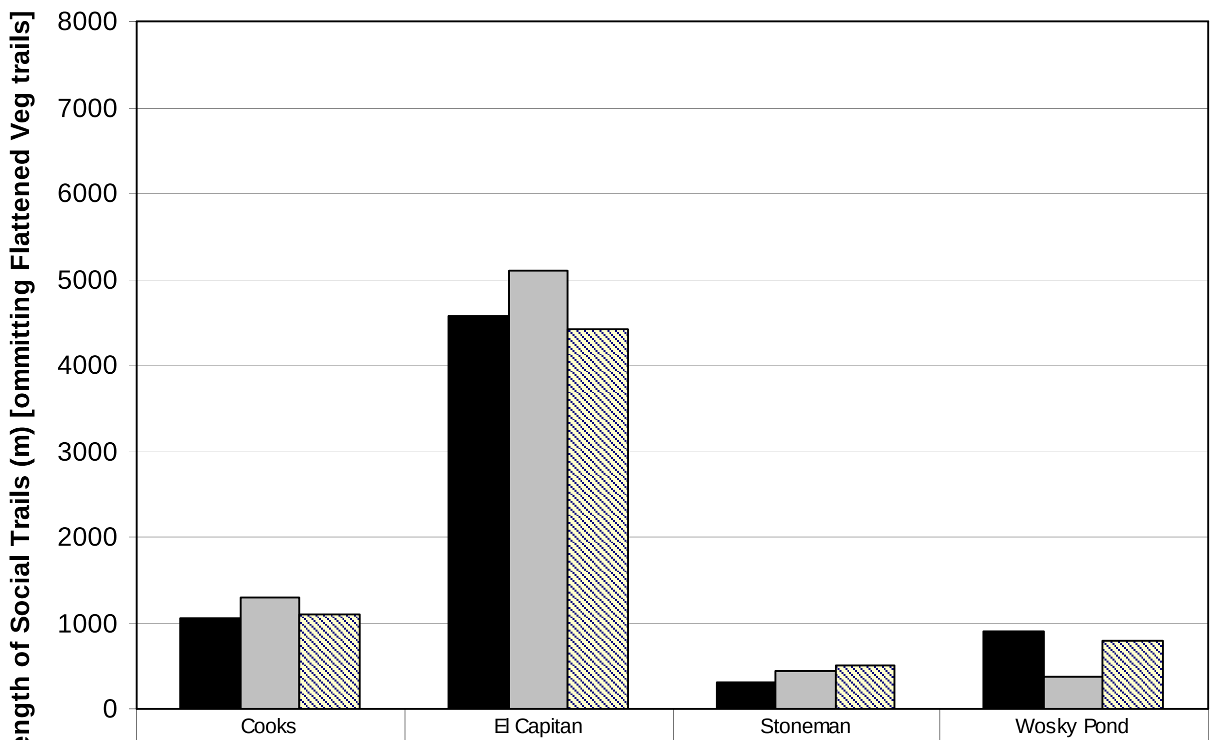
After further scrutinizing monitoring results, it became apparent that among-year variation in non-formal trail density could largely be attributed to variation in the extent of “flattened vegetation” trails. The large influence of trails of this type on the variation of the dataset became apparent during review of results from density calculations made after omission of trails of this condition class. Results are given in Figure 2.2.7, which shows that among-year variability in non-formal trail density under this modified analysis actually seems to be quite small and not following any obvious trend (except in the case of Stoneman and Wosky Pond meadows to a certain degree, which will be examined in the discussion section). El Capitan meadow exhibits the highest non-formal trail density, by far, of all the meadows. Interestingly, Wosky Pond exhibited the second highest density of informal trails.

The idea to conduct calculations without “flattened vegetation” trails emerged from discussions regarding the esoteric and circumstantial nature of these trails, which can be created by just one person/animal traveling through the meadow on one occasion and, by their nature, must vary greatly from year to year. It seemed unreasonable to make assertions regarding trends in non-formal trail development when such large variation was limited mainly to only the lowest condition class. In the future, other indicator measures such as linear measures and integrated indices may be applied to the monitoring of informal trails. Figure 2.2.8 was included to provide perspective on density data relative to changes in linear extent of informal trails.



	Cooks	El Capitan	Stoneman	Wosky Pond
2004	0.008341686	0.023296246	0.006383276	0.019333466
2005	0.010277959	0.025961636	0.009051472	0.008068343
2006	0.008613131	0.022466647	0.010423194	0.017100132

Figure 2.2.7. Density of informal trails (omitting "flattened vegetation" trails) in Yosemite Valley meadows monitored in 2006.



	Cooks	El Capitan	Stoneman	Wosky Pond
2004	1060.27	4575.01	310.48	892.34
2005	1306.38	5098.45	440.26	372.396
2006	1094.772	4412.09	506.98	789.26

Figure 2.2.8. Total length of informal trails (omitting "flattened vegetation" trails) in Yosemite Valley meadows monitored in 2006.

Discussion: 2006 monitoring efforts and the resulting spatial dataset were products of applying lessons learned in 2004 and 2005 to streamline indicator methodology, utilizing personnel more familiar with GPS and GIS technologies, and developing a greater understanding of the VERP process in general. These improvements facilitated the acquisition of quality data while substantially reducing the financial requirements for the monitoring of this indicator. Similarly to previous years, many of the observed informal trails originated from roadways, parking areas, designated trails, and boardwalks, which suggest that planning should focus on accommodating visitor use radiating from these areas.

As mentioned above, the variation in the density of informal trails in the monitored meadows between 2004 and 2006 was quite small (except in Wosky Pond, see discussion below) when considering those trails that displayed levels of impact that are of most concern and that are permanent in nature (i.e. not "flattened vegetation" trails). The slight increase in informal trails observed in Stoneman meadow observed even after the modified analysis will be an area of focus in following field seasons to confirm trends and investigate potential causes. The results from 2004 and 2005 monitoring comprise a high-quality baseline from which to compare results from future inventories, and 2006 results bolster 2004 and 2005 findings. The methodology from this indicator will continue to be refined, but the methods have proven largely successful and will be able to be utilized in the upcoming years to monitor this indicator.

The large fluctuations in the amount of "flattened vegetation" trails (those of the lowest condition class and exhibiting the lowest levels of impact) observed among years may be attributable to a variety of factors (which were discussed at length in the 2005 report) that are not necessarily related to changes in visitor use levels. These include, but are not limited to, annual variation in plant productivity influencing resiliency of the meadow to trampling, timing of monitoring relative to animal migration or meadow research projects (which contribute significantly to the amount of "flattened vegetation" trails), and issues with quality control related to detection levels of faint, "flattened" trails in high-density situations. This suggests a revision to the current methodology that should include either (1) inventorying only those trails falling into condition class two ("stunted vegetation") and higher, since mapping "flattened vegetation" trails can be problematic given the reasons mentioned above, or (2) conducting inventories at time intervals large enough to enable detection of changes in non-formal trail density truly related to visitor use impacts (making the collected data more robust) and not those caused only by annual environmental variation, etc.

The challenges experienced related to detection sensitivity, standardization of recorded condition classes, and determining optimum time intervals between monitoring efforts include some that have been encountered in other studies seeking to quantify non-formal trail impacts (Leung and Meyer 2004, Marion et al. 2006, Newman et al. 2006). Thus, the VERP program in Yosemite National Park is on the cutting edge with the recreational ecology research community as we strive to refine this methodology to provide the best quality data to park planners and management.

The substantial discrepancy in social trail length among years in Wosky Pond meadow was investigated, and it became apparent that the comparably low amount of social trails recorded in 2005 was attributable to the accidental omission of a particular non-formal trail network located in the eastern portion of the meadow from the GPS inventory. This omitted length of trail, while not impacting results to a large extent had it been located in El Capitan meadow, had a substantial effect on non-formal trail density calculations in the relatively small Wosky Pond meadow. The relatively high density of informal trails observed in this meadow warrants further examination to confirm trends and investigate potential causes, and should be a focus of monitoring efforts in upcoming field seasons.

The sampling discrepancies throughout 2006 at Wosky Pond reinforced the importance of including a detailed map depicting results from previous GPS inventories in the list of supplies needing to be obtained by the field technician prior to monitoring. This map should accompany the field technician into the meadows being investigated, and they should carefully refer to it during monitoring to ensure that they are not overlooking any existing non-formal trail networks.

2007 efforts will initially focus on developing a methodology for GIS analysis of changes in density of informal trails and disturbed areas. This will be accomplished through utilization of GIS raster datasets created from the GIS shapefiles depicted above and will involve fragmentation statistics to investigate spatially-oriented trends in non-formal trail and disturbed area proliferation. In addition, the lessons learned from the previous seasons will applied to development of our approach to the 2007 field season in order to maximize efficient collection, analysis, and management of quality data.

2.3. WILDLIFE EXPOSURE TO HUMAN FOOD

The Merced River corridor provides habitat for a variety of animal species. Myriad insects, birds, amphibians and mammals depend on the river and its surroundings for survival. This wildlife is part of the Merced River's biological Outstandingly Remarkable Values. However, studies have shown that human use may have an adverse impact on wildlife (Decker et al. 1992, Manfredo et al. 1995). Impacts include loss of habitat and food, predation, habituation, and others.

Of particular concern in many national park units is the feeding of wildlife. In Yosemite Valley human-bear interactions have been of concern. The Black Bear (*Ursus americanus*) is quite common in the park and human interaction with them is frequent. These interactions, however, have not always been positive. Often visitors will make their food available to bears by leaving it un-attended at their campsite or in their car. There are documented instances of bears breaking into visitors' vehicles or rummaging through their camp to obtain this food. Bears can become conditioned to human food and are intelligent enough to pursue this food source to the detriment of both the animal and the visitor. A bear's ability to successfully survive in the wild is diminished when it becomes conditioned to human food. And bear "break-ins" to visitors' vehicles and campsites can cause significant impacts to personal property and the quality of a visitors' experience.

Therefore, an indicator was developed in 2004 to measure visitor compliance with food storage regulations. Compliance rates provide meaningful information as to the extent to which human food may be available to bears. This is indicative of the extent to which human use in the Merced River corridor is causing negative impacts to bear populations.

Measurement: Percent compliance with food storage regulations at selected sights.

Standards: 95% or greater compliance with food storage regulations in selected campgrounds and parking areas.

Zones:
- 2C Day Use
- 2D Attraction
- 3A Camping
- 3B Visitor Base and Lodging

Sampling: The monitoring data for this indicator was collected and incorporated into the Bear Patrol Log Database (BPLD). The BPLD was developed for the Human-Bear Management Program (HBMP) in 2005 to ensure accountability with HBMP-funded employees and to collect data on bear monitoring and management activities in the field. In Yosemite Valley, there are an average of 15 HBMP-funded employees that spend at least 80% of their time on bear related issues between the months of May and September. These employees include Protection, Campground and Interpretation Rangers, and Wildlife Technicians. While the primary duties differ among work units, all employees share the common goal of mitigating human-bear conflicts and protecting wildlife from exposure to human food. This is accomplished through proactive patrols between the hours of 5 p.m. and 4 a.m. when bear activity is the greatest. During patrols, visitors are educated about proper food storage through one-on-one interpretive contacts, campsites and vehicles are checked for food storage compliance, and food storage regulations are enforced through verbal or written warnings and citations.

Non-compliance includes the following violations:

1. Feeding human food to wildlife – Knowingly offering human food or baiting wildlife.
2. Improper food storage – Human food stored in locations that are considered inappropriate, such as inside vehicles after dark or in containers that are not approved by the park as wildlife resistant;
3. Improper use of food locker – Food is put in food locker but the locker is wide open, unlocked, or not latched in a way consistent with the instructions provided and the visitors are either away from their site or asleep.
4. Leaving food unattended – Food left in open locker, out in campsite, or other location where the food is out of arms reach, is not actively being prepared or eaten, and/or the food is not visible to any of the camp occupants.

Campground inspections to determine compliance rates were generally conducted after 10 p.m. when most visitors were finished eating dinner and food was put away. Inspections conducted earlier than 10 p.m. often resulted in a very low compliance rate because most people preparing dinner had their food lockers open and food items out of arms reach. These incidents were documented in the BPLD as educational contacts rather than violation or inspection records.

Parking lot inspections were conducted throughout the night, but because food stored inside vehicles during daylight hours is legal, compliance checks on vehicles could only be performed after dark.

Average compliance rates were determined by inspecting either a certain number of campsites or vehicles. The number of food storage violations was also documented, but not necessarily as part of an inspection. On many occasions, especially when responding directly to bear activity, food storage violations were found, corrected and documented, but were not calculated in the average compliance rate for an area because they were not part of an inspection. In the BPLD, food storage violation records can either stand alone or be part of an inspection record.

Figure 2.3.1. Bear control food storage lockers.

Results:

1. General Compliance

The primary measure for this indicator is *compliance rate*, or the extent to which visitors comply with Yosemite's food storage regulations. Table 2.3.1 presents results of compliance analysis based on the wildlife patrol log database. To be comparable with the 2005 Annual Report, data of six major inspection locations (Table 2.3.1) were presented in this report. Data represents inspections and violations that occurred between May 1, 2006 and September 30, 2006. Inspections included only those with over 9 units inspected. Inspections were also only included if they occurred after 9 pm in May and September and after 10 pm June through July. Among these six locations a total of 75,654 inspections were conducted in 2006. Results show that Upper Pines (campsite inspection) and Curry Village Concessionaire parking lots only (vehicle inspection) had the highest overall compliance rates (OC) of 98.92% and 95.92%, respectively, whereas Camp 4 campsites had the lowest overall compliance rate of 92.59%. It should be noted that Camp 4 is different than the other campgrounds surveyed. It is similar to other campgrounds in that there are only 6 visitors allowed per campsite. It is different in that in Camp 4, these visitors may or may not be associated with each other. It is possible on a given night that all 6 visitors are more like individual campsites. Because of this, it may be possible that number of campsites inspected is not an accurate picture of compliance rate. It may be more accurate to determine the average number of parties per night and use that as the number inspected. The average daily compliance (ADC) rates show similar patterns across locations. The gaps between overall and average compliance rates were close, ranging from 0.05% at Camp 4 (vehicle inspection) to 0.43% at Yosemite Lodge (vehicle inspection). All locations had standard deviations less than 9%, with Upper Pines inspections exhibiting the highest consistency at 1.46%.

Table 2.3.1. Results of general compliance analysis using two calculation methods.

Location	Inspection Type	# Inspected	*Overall* Compliance Rate (Formula 1)	*Average Daily* Compliance Rate (Formula 2)
Ahwahnee Parking Lot	Vehicle	6410	95.32%	95.49% (4.38%)*
Camp 4	Vehicle	12563	94.33%	94.38% (4.71%)
Curry Village	Vehicle	16031	95.92%	96.10% (3.05%)
Yosemite Lodge	Vehicle	25219	92.85%	93.28% (4.32%)
Camp 4	Campsite	3186	92.59%	92.65% (8.48%)
Upper Pines	Campsite	12245	98.92%	98.92% (1.46%)

* Standard deviation listed in parenthesis.

2. Monthly Compliance

Detailed results of monthly compliance are provided in Table 2.3.2. All locations achieved a compliance rate of over 90%. Upper Pines Campground was the only location to exceed the 95% standard during all five months.

Table 2.3.2. Monthly compliance rates by location.

Location	Inspection Type	# Inspected	*Overall* Compliance Rate (Formula 1)	*Average Daily* Compliance Rate (Formula 2)
May				
Ahwahnee Parking Lot	Vehicle	100	93.00%	91.33% (9.87%)*
Camp 4	Vehicle	2007	94.12%	94.66% (5.21%)
Curry Village	Vehicle	1284	99.22%	98.98% (1.72%)
Yosemite Lodge	Vehicle	3380	93.37%	95.20% (4.69%)
Camp 4	Campsite	209	95.69%	95.71% (0.65%)
Upper Pines	Campsite	2880	98.96%	98.96% (0.65%)
June				
Ahwahnee Parking Lot	Vehicle	688	98.11%	98.39% (2.21%)
Camp 4	Vehicle	2470	94.13%	94.43% (3.95%)
Curry Village	Vehicle	2289	96.64%	96.64% (2.78%)
Yosemite Lodge	Vehicle	5284	90.88%	91.06% (3.65%)
Camp 4	Campsite	559	91.59%	91.61% (8.82%)
Upper Pines	Campsite	1350	97.70%	98.07% (3.05%)

Location	Inspection Type	# Inspected	Overall Compliance Rate (Formula 1)	*Average Daily* Compliance Rate (Formula 2)
July				
Ahwahnee Parking Lot	Vehicle	1764	94.56%	95.10% (4.18%)
Camp 4	Vehicle	2536	92.55%	92.16% (5.77%)
Curry Village	Vehicle	5209	96.01%	96.23% (2.75%)
Yosemite Lodge	Vehicle	6149	92.41%	93.21% (3.40%)
Camp 4	Campsite	690	93.62%	93.62% (4.99%)
Upper Pines	Campsite	1640	99.45%	99.46% (0.58%)

Location	Inspection Type	# Inspected	*Overall* Compliance Rate (Formula 1)	*Average Daily* Compliance Rate (Formula 2)
August				
Ahwahnee Parking Lot	Vehicle	2308	95.88%	96.14% (4.40%)
Camp 4	Vehicle	2934	94.31%	91.42% (4.16%)
Curry Village	Vehicle	4592	94.56%	94.33% (3.55%)
Yosemite Lodge	Vehicle	6768	93.69%	93.65% (3.20%)
Camp 4	Campsite	665	93.68%	93.68% (8.76%)
Upper Pines	Campsite	2759	99.42%	99.22% (1.44%)

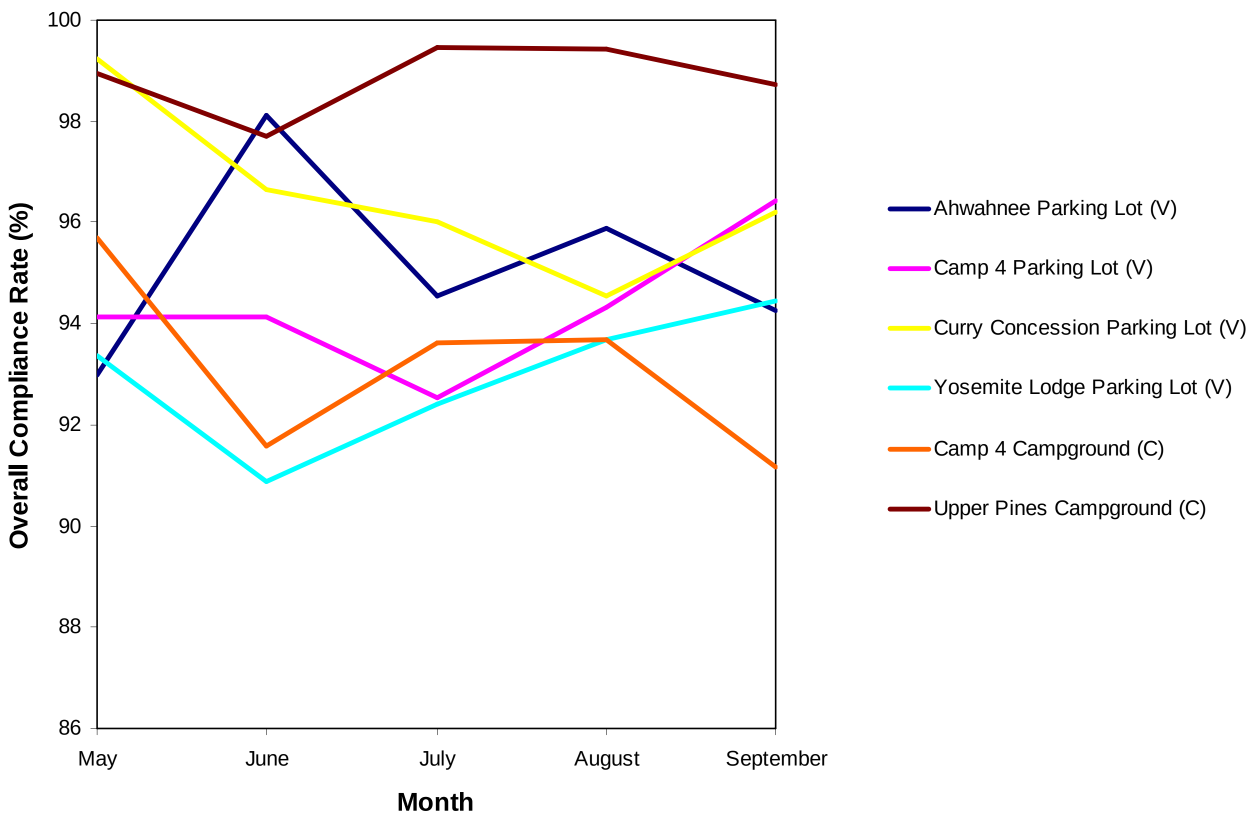
Table 2.3.2. Monthly compliance rates by location (continued)

September				
Location	**Inspection Type**	**# Inspected**	***Overall* Compliance Rate (Formula 1)**	***Average Daily* Compliance Rate (Formula 2)**
Ahwahnee Parking Lot	Vehicle	1550	94.26%	94.31% (3.60%)
Camp 4	Vehicle	2616	96.44%	96.39% (3.49%)
Curry Village	Vehicle	2657	96.20%	96.36% (1.71%)
Yosemite Lodge	Vehicle	3638	94.45%	93.61% (6.62%)
Camp 4	Campsite	1063	91.16%	91.33% (10.37%)
Upper Pines	Campsite	3616	98.73%	98.80% (1.13%)

* Standard deviation listed in parenthesis.

Figure 2.3.2 portrays the overall compliance rates of inspection locations over the 2006 use season. Upper Pines Campground (campsite inspection) exhibited high levels of stability over the use season, while the compliance at the other five locations was less stable. For example, the Ahwahnee Parking Lot ranged from 93% to 98.11% throughout the season and Curry Concession Parking Lots ranged from 94.56% to 99.22%

Figure 2.3.2. Overall compliance rates by month and location (V=vehicle inspection; C=campsite inspection).



(B) Types of Violations

The BPLD documented the type of violation for each non-compliance record. An understanding of the distribution of violation types in different locations can help customize management and public communication strategies at specific facilities and use areas. Table 2.3.3 displays the distribution of violation types across six major inspection locations and across the eight different violations that are tracked during inspections.

Table 2.3.3. Frequencies of violations by type and location.

Violation Type	Ahwahnee Parking Lot (V)*	Camp 4 (V)	Curry Village (V)	Yosemite Lodge (V)	Camp 4 (C)	Upper Pines (C)	Total (Type)
Unattended food or attractant in vehicles	287	697	664	1981	0	67	3696
Unattended food or attractant	1	3	3	0	106	317	430
Food Locker/left open	0	0	0	0	159	487	646
Food taken by bear/Visitors in campsite	0	0	0	0	0	5	5
OB camper w/ food in vehicle	10	6	7	7	0	0	30
Visitors too far from food	0	4	0	0	251	226	481
Food Locker/Improperly locked	0	0	0	0	281	132	413
Baiting	0	0	0	0	0	2	2
Total *(Location)*	**298**	**710**	**674**	**1988**	**797**	**1236**	**5703**

* V = Vehicle inspection; C = Campsite inspection

The results indicate that unattended food or attractant in vehicles was the most common type with almost 3700 counts of violation. Yosemite Lodge (vehicle) appears to have a significant problem with visitors leaving their food or attractant unattended in vehicles. Campgrounds had a wider range of violations, especially those related to food locker use and visitors too far from food.

Discussion: Results from the 2006 field season suggest that food storage compliance rates at most major locations approached or exceeded the proposed standard of 95%. Management attention is needed for certain locations, such as Camp 4 campsites, especially in high-use summer months. More effective communication seems to be appropriate for addressing the violation of leaving food/attractant in vehicles, especially in the Yosemite Lodge area.

As far as the protocols are concerned the procedures seem to work well and efficiently. There are two recommendations on the database structure that would facilitate data reporting and analysis. First, there needs to be clarification regarding where non-compliance is listed in the database tables. For instance, in the report on compliance for all locations, there is a column titled “non-compliance”. However, the instances of non-compliance listed here do not match with the number of violations because they are not tied directly to the inspection in the database.

The sub-sampling test results suggest that the compliance rates calculated are stable. However, this finding was based on a large volume of inspection data even in the sub-samples. For locations with only limited number of inspections the compliance rates may be sensitive to when the data are collected. More detailed sensitivity tests by location, time (e.g., time of day, weekend/weekday) and type of staff are suggested for the next field season to further examine and validate this issue.

Two methods of calculating compliance rates were explored and compared, and the results show very little difference between them. Again, it should be noted that the large number of inspections may have led to this result. At locations with low number of inspections, the average daily rates may be affected by several days with unusually high non-compliance. For simplicity of reporting with a large database the Overall Compliance Rate seems to be sufficient. Despite the sensitivity of the average daily method, it enables the evaluation of variation in compliance and detection of certain locations and dates with significant non-compliance problems. If there is interest in standard statements such as ‘no more than X days should have lower than Y% compliance’ or ‘no day should have lower than Z% compliance’ (absolute minimum), then the daily average method would provide results that support these supplementary standards besides general annual or monthly compliance.

2.4. RIVERBANK EROSION

Riverbank erosion has been selected as an indicator because the soils and vegetation that stabilize them are essential to the integrity of riparian ecosystems. Although soil erosion occurs along the river as a result of natural river processes, such erosion can be accelerated and exacerbated by visitor use. Increasing visitor use on susceptible substrates often results in increased soil erosion. Therefore, this indicator is valuable for assessing a site's ability to sustain varying types and levels of visitor use.

Riverside soils and vegetation affect water quality by regulating the entry of groundwater, surface runoff, nutrients, sediments and other particulates, and fine and coarse organic matter to rivers and streams. Accelerated erosion associated with trampling and visitor access can alter these processes, leading to changes in hydrology and water quality.

In addition to indicating loss of soil, erosion may affect cultural Outstandingly Remarkable Values. The amount of riverbank erosion associated with visitor use will be used as an indicator of changes that may be occurring to any cultural resources—namely to archeological sites—that may exist along the river corridor. Riverbank soil erosion that occurs at archeological sites would suggest a potential loss of site stability and loss of intact archeological artifacts and features, critical components of archeological site integrity. Once artifacts and features are displaced from their original context or lost, the information inherent to those deposits is also lost.

Measurement: Two sampling strategies were used to measure riverbank erosion (see 2006 VERP Field Guide for complete descriptions):

1) Permanent monitoring sites- A thorough and technical assessment of river geomorphology/bank structure and riparian vegetation were conducted at selected sites. Total station surveying equipment was utilized to obtain cross- and longitudinal-sections, resulting in high-accuracy graphical depictions of both types of profiles at the individual river segments (cross section profiles are presented in this report). Photopoints were established to document visual changes in river and bank morphology over time. Riparian vegetation was assessed following a protocol adopted from Winward 2000 and Herrick et al. 2005. Pebble counts were executed following the Wolman method to characterize substrate type.

2) Rapid assessment plots- These plots will be assessed using methods employed in 2005. Riverbank erosion will be assessed using two metrics: (1) vegetation condition rating and (2) erosion condition rating. Ratings for each metric are based on a four-point Likert scale, with lower condition ratings indicating a lower level of vegetation impact and erosion, and higher condition ratings indicating a higher level of vegetation impact and erosion. A Riverbank Condition Index (RCI) was developed and will be used to integrate erosion and vegetation condition information into a single composite index. Other attributes that contribute to the degree of riverbank erosion will also be recorded, including type/slope of riverbank, substrate type, and existence of human impact.

Standard: Results from permanent monitoring sites will be used as a baseline comparison for future monitoring efforts. In terms of rapid assessments, a range of RCI threshold values will be developed through consultation with professionals specializing in ecology and river geomorphology. The resulting standard will vary by management zone depending on desired conditions designed to protect Wild and Scenic ORV's for individual zones. Following the development of threshold values, future monitoring results will be compared to the standard of no net increase over baseline (from 2005 inventory) in linear extent of riverbank erosion that is accelerated or caused by visitor use

Zone(s): 2B Discovery, 2C Day Use

Sampling: Riverbank erosion surveys were conducted at three sites in 2006 in Yosemite Valley: Pines Campgrounds, Sentinel Beach, and El Cap Dump. At each site, streambank morphology was surveyed using a total station. Surveys were made of cross sections, as well as longitudinal profiles of the thalweg, bank bottom and bank tops on each side. Pebble counts and vegetation profiles were completed along the cross sections. Photopoints were taken from the permanent monuments of each cross section, and from the middle of the river (upstream, downstream, and to the right and left banks). Rapid assessments were also performed at each site.

Vegetation plots were read from the bottom of the bank to the top of the bank. Some steep banks had the minimum of two plots, one top and bottom. Some banks incorporated wide point bars and cutoff channels. The longest transect, at Sentinel Beach, had 24 plots.

Site Descriptions:

Pines Campgrounds- This area was chosen because it receives heavy visitor use. Existing cross sections 10-13 were resurveyed. The surveyed reach starts 50 meters downstream of Clark's bridge, and continues downstream for 400 meters. Looking downstream, the left side of this area is Lower Pines Campground, while the right is North Pines Campground. Both sides are heavily used by campers, as well as by other visitors who access the river by the bridge. In general, there is little herbaceous or shrub cover. Root exposure is extreme (inspiring the term “mangrove pines”). Stumps in the channel show where the bank has eroded away. These stumps comprise the bulk of the large woody debris. Combined with large scalloped areas in the bank and the compacted soil, this area is an excellent example of human-caused erosion.

It should be noted that the vegetation increases in cover drastically on the downstream portion of the left bank, where the campground has been closed since the 1997 flood.

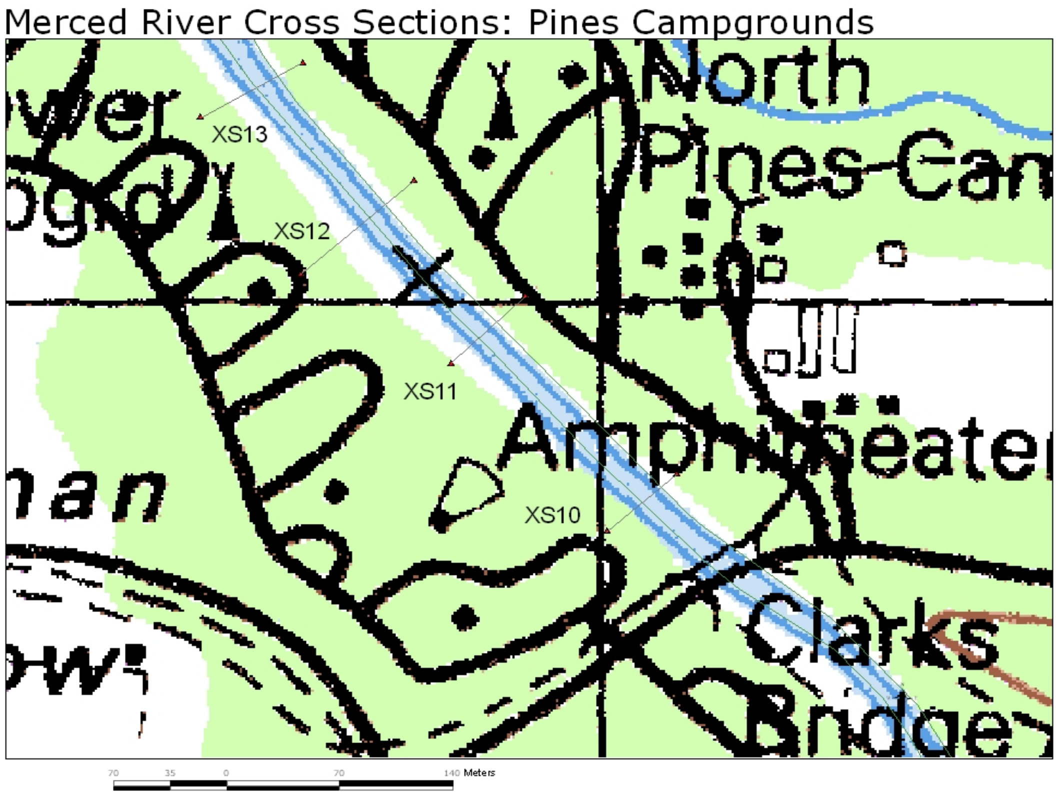


Figure 2.4.1. Map of cross-sections at Pines Campground.

Sentinel Beach- This area was chosen because it receives moderate visitor usage. This official picnic area is the takeout spot for commercial rafting. Four new cross sections were installed here, from 70 to 73. The surveyed reach starts 300 meters downstream of Swinging Bridge, and continues downstream 200 meters. Long transects on each side of the river incorporate wide riparian terraces and cutoff channels below upland vegetation.

Looking downstream, the left side of this area is the Sentinel Beach picnic area. Restoration fences seem to keep the bulk of visitors on the expansive beach and gravel bar, although there are numerous social trails in the area. Herbaceous cover is relatively high at this site. Bare areas tend to be gravel or sand bars, rather than the result of trampling. A perennially inundated oxbow on the downstream portion of the cross section harbors mosquitoes, which may further encourage people to stay on the dry beach area. Sentinel Creek enters the river in the middle of this reach.

Leidig Meadow lies on the river-right side of this segment, as it receives little use. Two small social trails parallel the river. A portion of this reach is steep and actively eroding. A large scallop has developed where people cross the river from the picnic area to access the meadow. Visitors also access a beach on the upstream cross section and further upstream. This side has two old riprap wing dams, and the river is eroding the area upstream of the lower one.

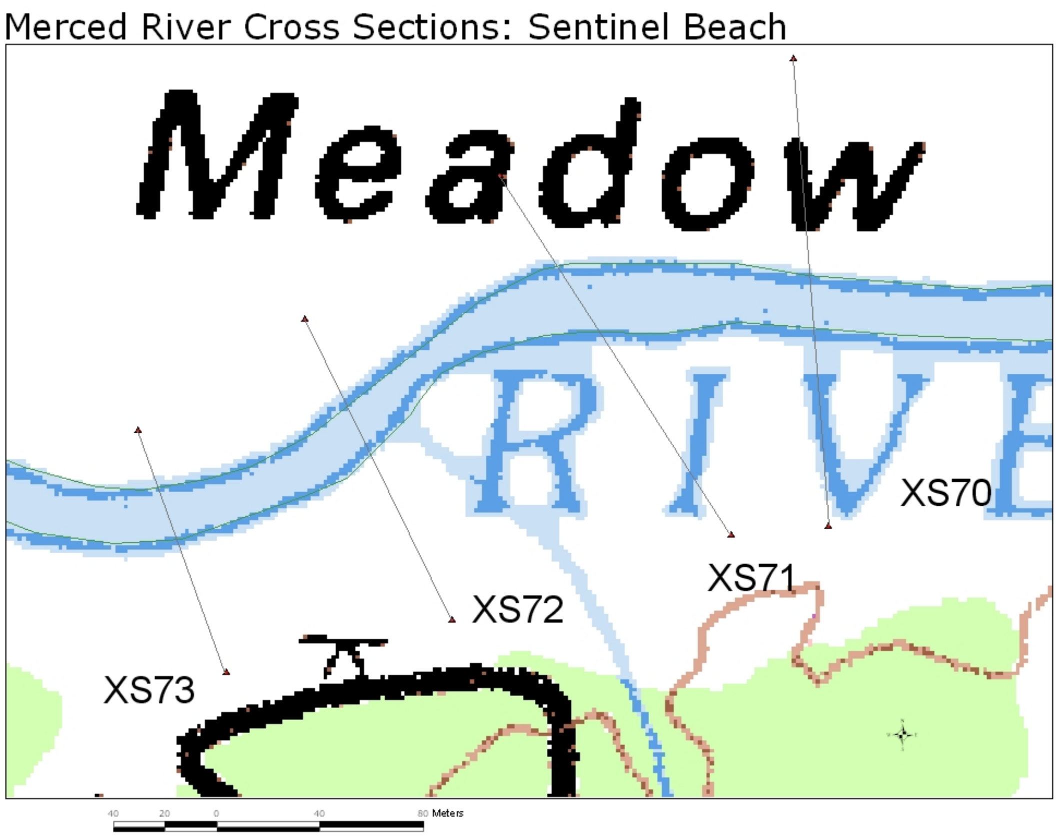


Figure 2.4.2. Map of cross-sections near Sentinel Beach.

El Cap Dump- This area currently receives little visitor use, although it did historically. The surveyed reach starts 1600 meters downstream of Eagle Creek, at cross section 30. It continues 200 meters downstream and encompasses existing cross sections 30-34. This reach of the river is not visible from the road.

Looking downstream, the right bank used to be the El Cap picnic area and the El Cap dump. Neither is currently active, but the dump material is still in place (and eroding into the river). There are no official pullouts on the north/right side of the river, although the Valley loop trail passes by this section. The bank on this stretch is steep and actively eroding.

The left bank has a wide beach with riparian vegetation and cutoff channels. A small paved pullout on Southside Drive leads to the left side of the river and a large beach, but few visitors use this area.

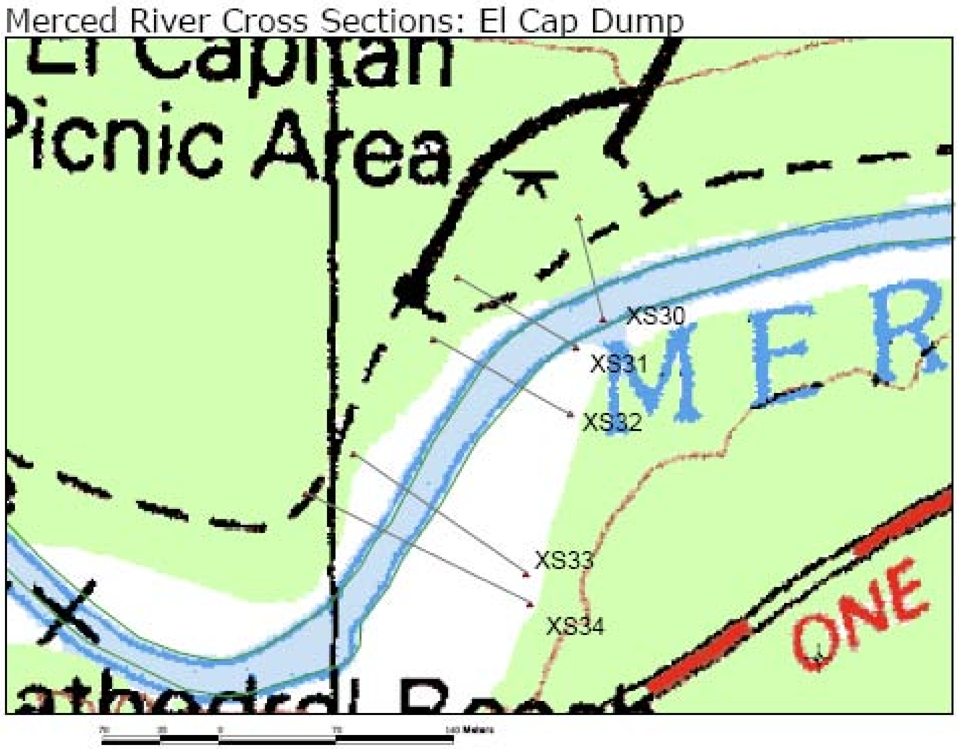


Figure 2.4.3. Map of cross-sections near El Cap dump.

Results: The three sites yielded very different data, with the medium use site (Sentinel Beach) being more similar to the low use site (El Cap Dump) than the high use site (Pines Campgrounds).

Pines Campgrounds had a total of 22 plots along its four transects. The total species count was 21 (Figure 2.4.4). There were 13 herb species (7 native, 1 nonnative, and 5 unknown), 3 shrub species (all native), and 5 tree species (all native) (Figures 2.4.5, 2.4.6, and 2.4.7). Average herb cover across all the plots was 9.32% and average shrub cover was 4.09%. There were 146 trees, or 5.5 per cross section and 6.64 per plot. The most abundant tree species was black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), although these were mostly saplings under 2m tall. Of the recorded herb cover, 78.0% was native. Sedges and rushes (*Carex* sp. and *Juncus* sp.) accounted for the bulk of the herb cover.

Only 9 pieces of large woody debris (LWD) were counted over each 100 m section, the lowest count of any site (Figure 2.4.8).

Sentinel Beach had a total of 94 plots along its four transects, which incorporated a wider floodplain and point bar. The total species count was 50 (Figure 2.4.4). There were 41 herb species (28 native, 9 nonnative, and 4 unknown), 2 shrub species (1 native and 1 nonnative), and 7 tree species (6 native and 1 nonnative) (Figures 2.4.5, 2.4.6, 2.4.7). Average herb cover across all the plots was 43.32% and average shrub cover was 4.02%. There were 436 trees, or 109 per cross section and 4.64 per plot. The dominant tree species was black cottonwood (*Populus balsamifera* ssp. *trichocarpa*). Of the recorded herb cover, 66.6% was native. The dominant herbs were bent grass (*Agrostis* sp.), *Leymus triticoides*, annual hairgrass (*Deschampsia danthoniodes*), sedges (*Carex* sp.) and *Scirpus microcarpus.*

Sentinel Beach had 18 pieces of large woody debris (LWD) over each 100 m section, the highest count of any site (Figure 2.4.8).

El Cap Dump had a total of 65 plots along its five transects, which incorporated a wider floodplain and point bar. The total species count was 50 (Figure 2.4.4). There were 39 herb species (25 native, 6 nonnative, and 8 unknown), 3 shrub species (all native), and 8 tree species (all native) (Figures 2.4.5, 2.4.6, and 2.4.7). Average herb cover across all the plots was 38.85% and average shrub cover was 4.19%. There were 390 trees, or 78 per cross section and 6.0 per plot. The dominant tree species was black cottonwood (*Populus balsamifera* ssp. *trichocarpa*). Of the recorded herb cover, 59.4% was native. Dominant herbs were bent grass (*Agrostis* sp.), blue wildrye (*Elymus glaucus*), annual hairgrass (*Deschampsia danthoniodes*), inflated sedge (*Carex vesicaria*), *Scirpus microcarpus,* and mugwort (*Artemesia douglasiana*).

El Cap Dump had 12 pieces of large woody debris (LWD) over each 100 m section, the middle count compared to other sites (2.4.8).

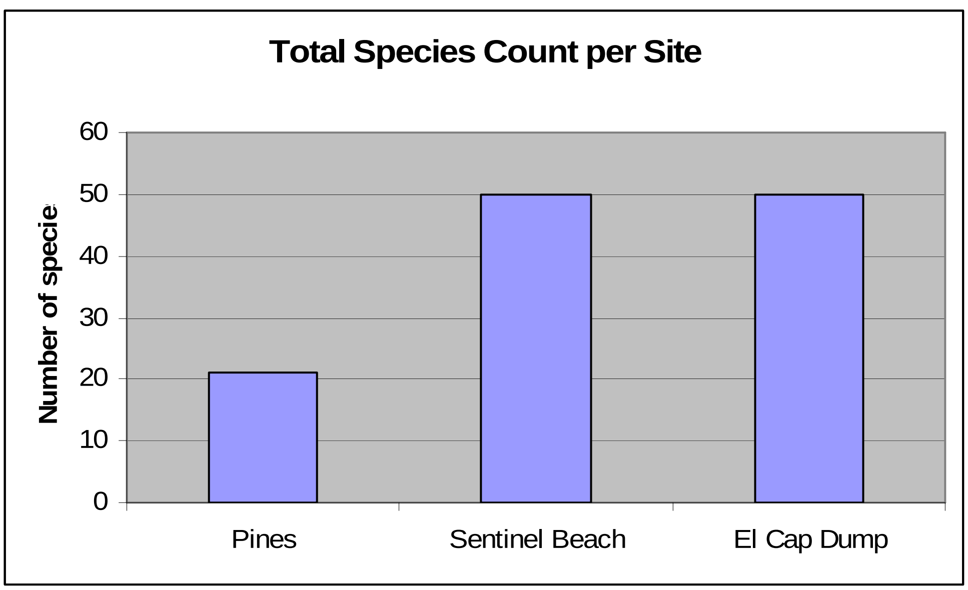


Figure 2.4.4. Total species count observed at each of the three permanent monitoring sites.

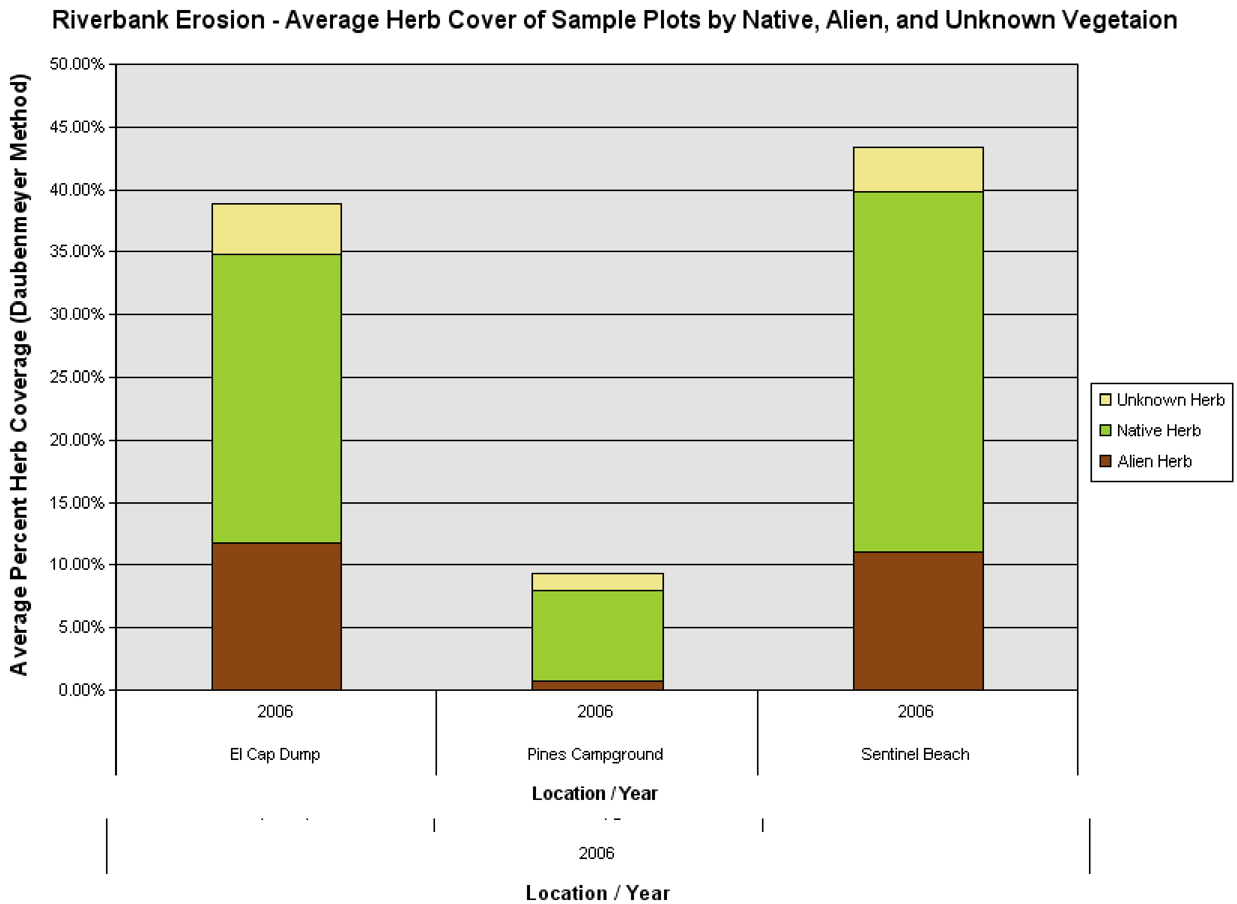


Figure 2.4.5. Average cover and related native status of herbaceous species observed in sample plots at each of the three permanent monitoring sites.

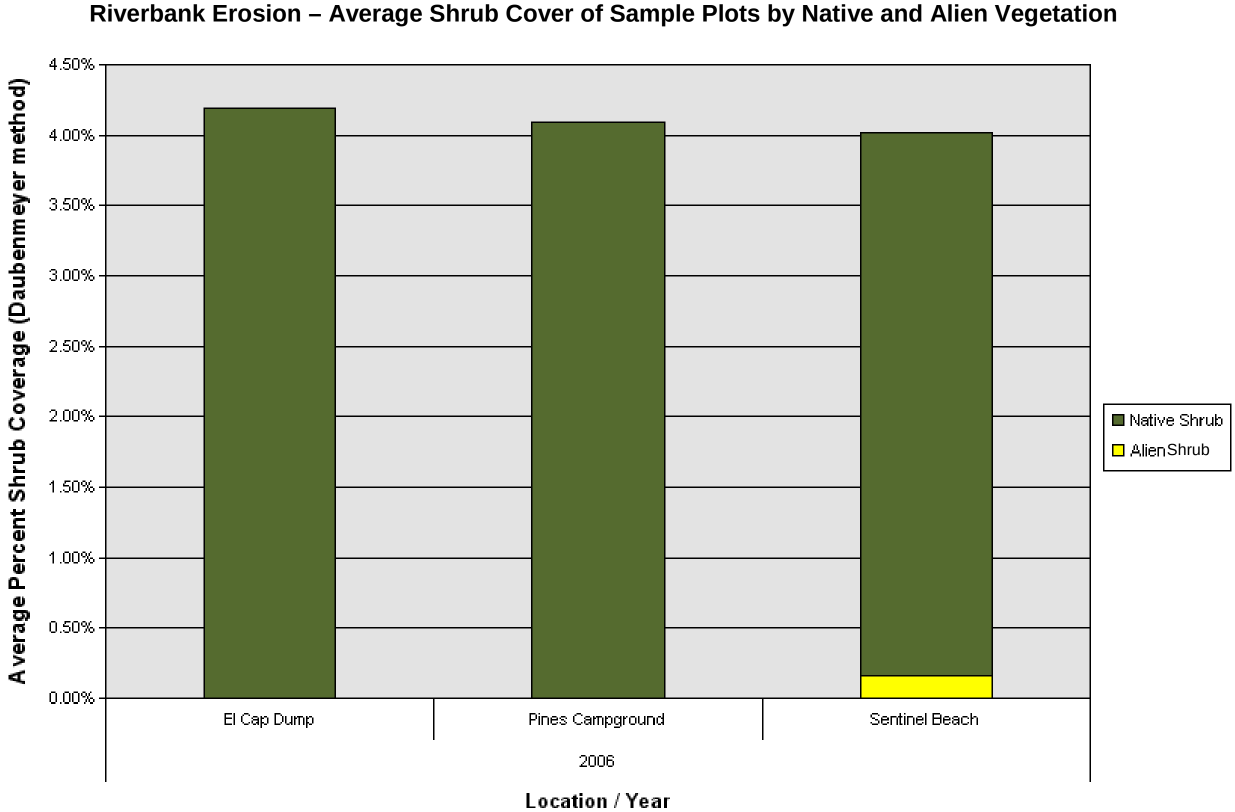


Figure 2.4.6. Average cover and related native status of shrub species observed in sample plots at each of the three permanent monitoring sites.

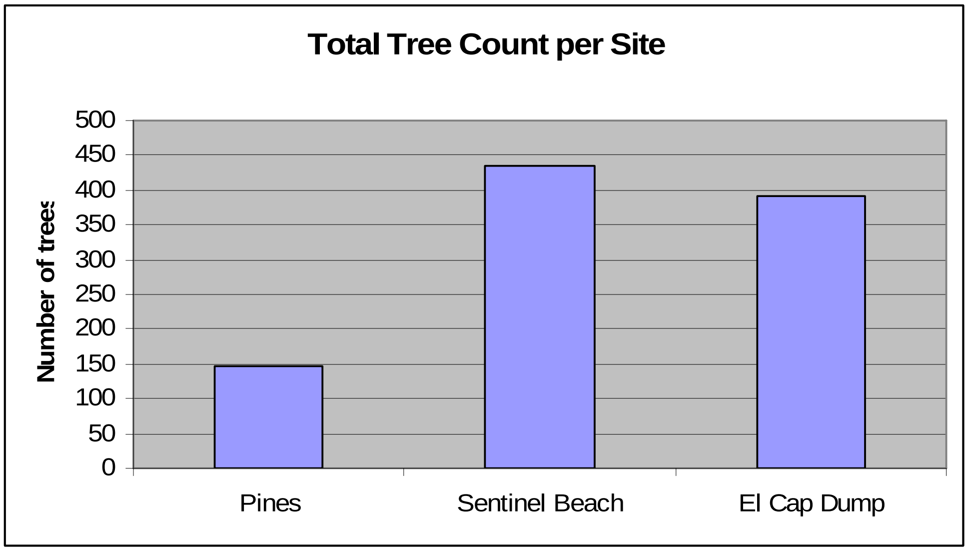


Figure 2.4.7. Total tree count observed at each of the three permanent monitoring sites.

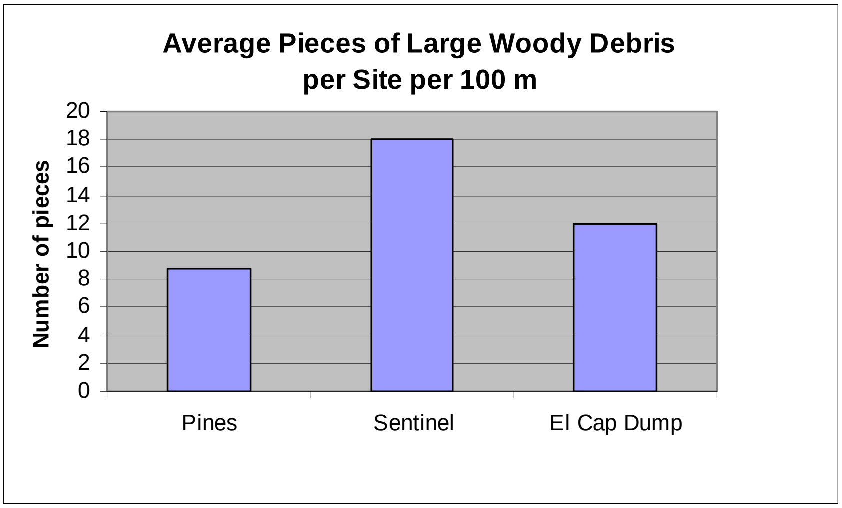


Figure 2.4.8. Average number of pieces of Large Woody Debris observed at each of the three permanent monitoring sites.

Results of the pebble count show that the Pines campground exhibited the highest percentage of coarse substrate, while substrate at the El Cap dump site was characterized by comparably little coarse material, and Sentinel Beach exhibited virtually none at all (Figure 2.4.9). Conversely, Sentinel Beach showed the highest percentage of fine material, while the Pines campground had the lowest values.

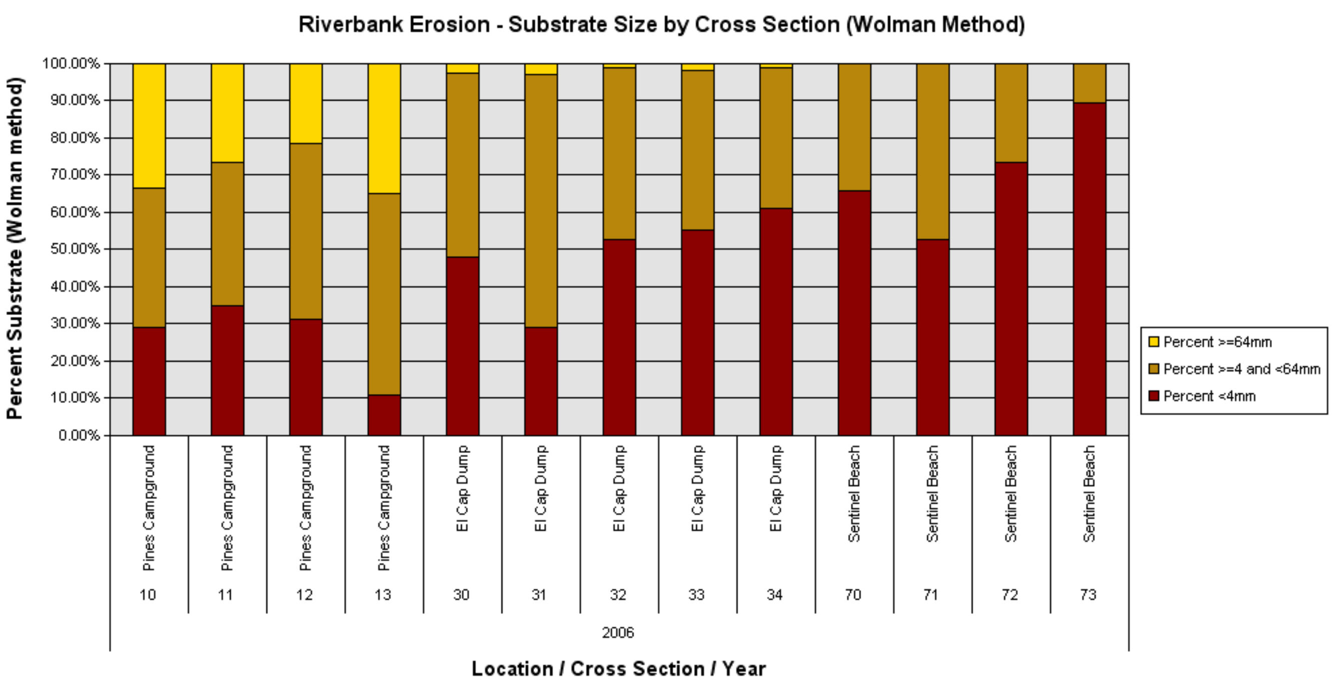


Figure 2.4.9. Results of the pebble count substrate analysis at each of the three permanent monitoring sites.

The following series of figures depict cross-sectional profiles of the river that were surveyed at the three permanent monitoring locations. The graphs show current (2006) morphology, but most also include the profile taken at the same point in 2001 or 2002 during previous cross section investigations (hence the pre-existing numbers associated with some of the cross-sections given in the figure captions). This allows for visualization of how the river has changed over the past four or five years. In addition, quantitative assessments of changes in river morphology have been achieved through scour and fill calculations using the Winscour™ software program. Cross sections at the Sentinel Beach site were not previously surveyed, so profiles shown are only those observed in 2006.

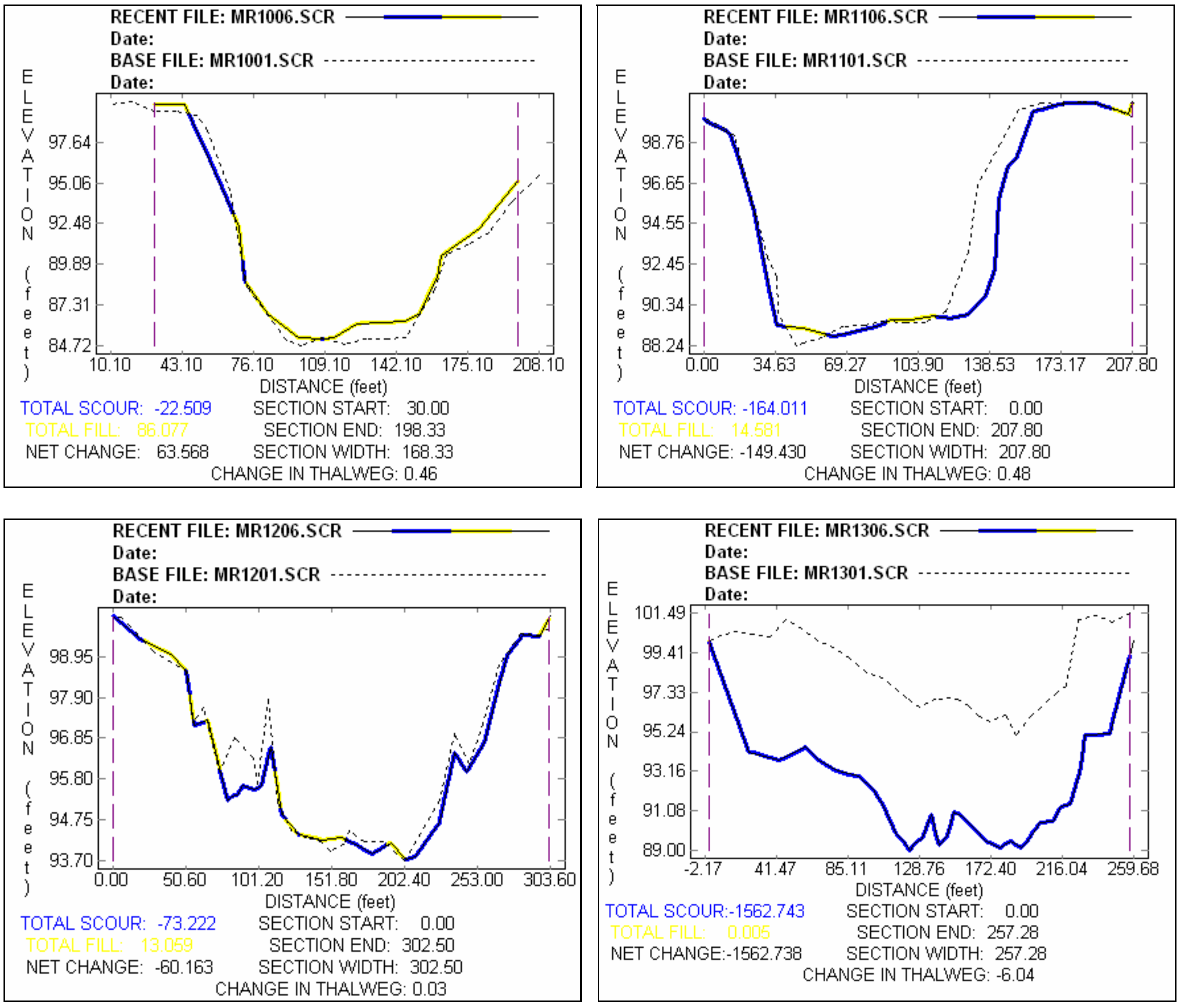


Figure 2.4.10. Merced River cross-sections surveyed in 2006 (colored line in which yellow represents fill quantities and blue represents scour quantities) and 2001 (dotted line) in the Pines campground site (top left= #10, top right= #11, bottom left=#12, and bottom right= #13, from upstream to downstream) created in Winscour™ software program.

Figure 2.4.11. Merced River cross-sections surveyed in 2006 (colored line, in which yellow represents fill quantities and blue represents scour quantities) and 2001 (dotted line) at the El Cap dump site (top left= #30, top right= #31, bottom left=#32, and bottom right= #33, from upstream to downstream) created in Winscour™ software program. Elevation is given in feet.

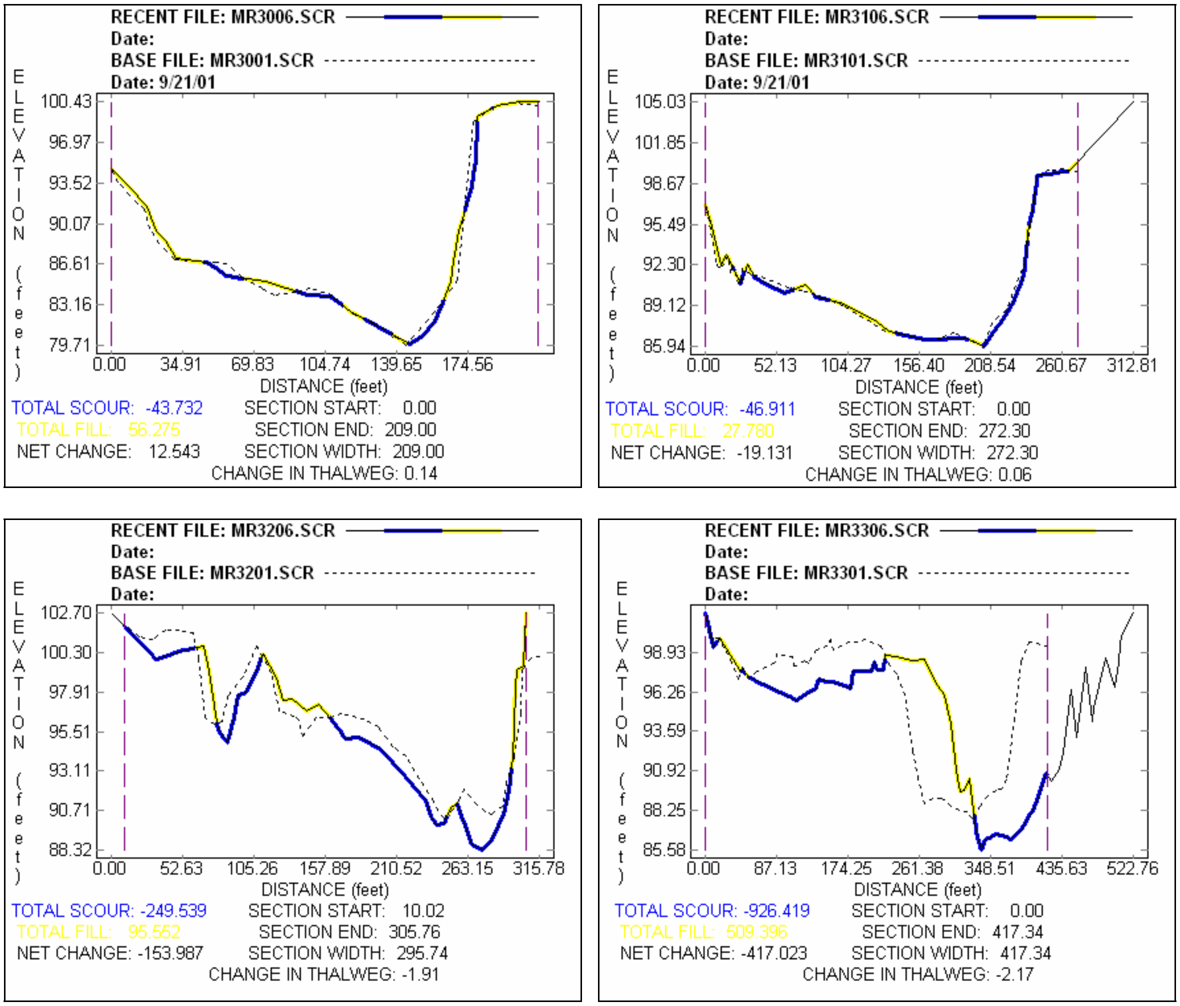
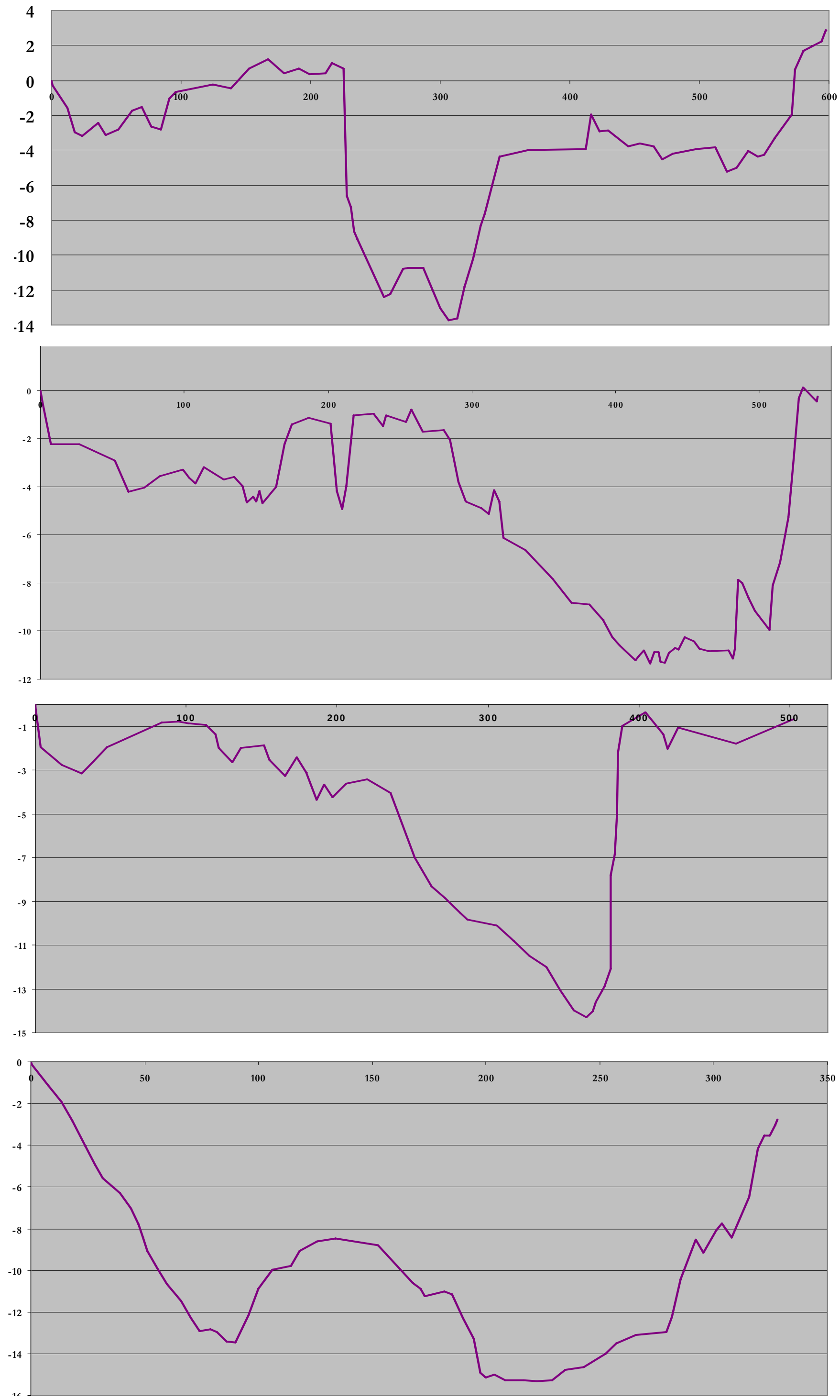


Figure 2.4.12. Merced River cross sections surveyed in 2006 at the Sentinel Beach site from upstream (top graph) to downstream (bottom graph). Data shown is the depth of riverbed below baseline (depicted as the incremented horizontal line) in feet. Horizontal graph lines occur in two-foot increments



Note: Longitudinal profile results are not presented here due to spatial constraints. Results from rapid assessments are not included because unforeseen circumstances prevented their preparation for publication within the time constraints of compiling this report. However, all data is available and can be obtained from the office of Vegetation and Restoration in the Division of Resources Management and Science in Yosemite National Park.

Discussion: Substantial expansion of this indicator's protocol for 2006 to initiate the implementation of permanent site monitoring strategies was the result of considerable planning and collaboration between park scientists and recreation ecology specialists. Field work was extremely time intensive, requiring the participation of three field technicians for daily monitoring needs, and the input of four or five staff in the field during troubleshooting sessions. Total station surveying equipment was used to achieve high levels of accuracy with regard to river morphology, a highly involved pebble count analysis was employed to characterize substrate, and rigorous plant community assessments were accomplished through utilization of standardized botanical methods. With this being said, the successful implementation of this new methodology was made possible only by the dedicated efforts of numerous park employees and collaborators.

Results presented in the beginning of the previous section provide a description of current observed conditions, and will serve as a baseline dataset for future monitoring efforts.

The Pines Campground showed much lower species diversity, with only about 40% of the species count found at the other two sites. It was also strikingly devoid of herb cover, with less than 24% of the cover found at the next highest vegetated site. These results show that the Pines campground area exhibits, by far, the greatest impact to plant community integrity of the three sites. This finding is not surprising given that this site was chosen for monitoring because of its "high use" characteristics. The riverbank adjacent to the Pines campground is already in the spotlight for its compromised ecological condition, and these monitoring data helps to provide quantitative support for steps that may be taken to ameliorate riverbank erosion impacts in this area.

It is interesting that the trees and shrubs were all native at Pines and El Cap Dump. Sentinel Beach had one plot with a nonnative shrub (Himalayan blackberry or *Rubus discolor*) and one plot with a nonnative tree (common apple or *Malus sylvestris*). Unknown herb species accounted for no more than 4% at any given site. All sites displayed similar levels of shrub cover. While there were significantly fewer total trees in Pines Campgrounds, it exhibited higher trees per plot than the other sites. This was due to the fact that the top of bank plots were overrepresented in Pines Campground (which had relatively few total plots).

The results of the substrate analysis show that coarse material content of the riverbed tends to decrease as one moves downstream (Figure 2.4.9). Such findings are logical in a hydro-geologic context in that the river's velocity, and therefore its capacity to suspend sediments, decreases as it flows through the relatively flat Valley floor. Larger sediments are deposited closer to the eastern end of the Valley as the river gradient decreases and water velocity slows, while finer sediments are still able to be suspended at lower water velocities and are carried further downstream. Interestingly, there are more fines at Sentinel Beach than El Cap Dump, which is the furthest site downstream. This may be attributed to potential sediment deposition by Sentinel Creek.

The following comprises a description of interesting results with regard to the cross-sectional data:
With regard to the Pines Campground site, only cross section #13 appears to have changed dramatically from 2001 to 2006, in which the bed elevation is shown to have lowered. ~1563 square feet of material was scoured from the riverbed, and the thalweg deepened by ~6 square feet. The cause of this change is unclear, and future monitoring efforts should include this cross-section to further investigate trends.

With regard to the El Cap Dump site, only cross section #33 appears to have changed dramatically from 2001 to 2006, in which the channel width appears to have shifted and widened. ~926 square feet of material was scoured, and ~509 square feet of material was deposited in the riverbed cross section. The thalweg deepened by ~2 square feet. The net change in streambed elevation from 2001 to 2006, however, is only 417 square feet (difference between scour and fill). Survey data in the left portion of this cross section is likely correct, in which material scoured along the left portion of the active channel was then deposited in the deeper part of the channel causing the thalweg to shift to the right. The presence of large woody debris in the right portion of the cross section may have potentially skewed readings in this area by making the profile unjustifiably erratic.

Prior to the upcoming field season, work groups are scheduled to discuss statistical methods for between-site and between-year comparisons of all monitored parameters, the sample sizes required to achieve optimal change detection levels through power analyses, and the conceptual relationship between actual field parameters measured at permanent plots and indices measured at rapid assessment areas.

2.5. ETHNOBOTANY

Ethnobotany is considered to encompass all studies which concern the mutual relationship between plants and traditional peoples (Cotton 1996). Plants have been used by native peoples for thousands of years for medicine, food, shelter, textiles, tools, and many other purposes (Ruppert 2001). Traditional plant gathering by indigenous populations is increasingly being recognized as an integral part of the cultural and natural significance of protected areas (Cotton 1996; Balick 1996; Pieroni 2006).

The Merced River corridor has many cultural features that contribute to the Cultural Outstandingly Remarkable Value of the river, including historic structures, archeological sites, and significant places of American Indian spiritual significance and traditional use. Both historically and contemporarily, local Indian people have played a significant role in the Merced River ecosystem. Through their traditional management of plant communities, they have helped to shape the landscape of the river corridor as we know it today. Their heritage can be found in archaeological caches and still today in their continued traditional practices. A new integrated indicator was formulated this year to address this latter cultural significance of the river corridor.

Native people have traditionally gathered a variety of flora found in the Merced River corridor. These gathered objects are used in traditional basketry, for medicinal purposes, for food, and in play. The continuation of these traditional gathering practices and preservation of plant populations is essential for the preservation of this outstanding cultural resource in the Merced River corridor.

Figure 2.5.1. Elderberry bush monitored for "usability" by practitioners in 2006.

Measurement: The practitioner usability of four traditionally gathered plant species:

- Bracken fern (*Pteridim aquilinum*) in Yosemite Valley; fiddleheads are a traditional food source, and filaments in the rhizomes are used in basket weaving.

- Blue elderberry (*Sambucus mexicana*) in canyonsides of the Merced River; berries are used for food, and stems are used in games and for musical instruments.
- Showy milkweed (*Asclepias speciosa*) in Yosemite Valley; stalk fibers used as cordage (representative Indian Hemp species).
- Redbud (*Cercis occidentalis*) in El Portal; used in basket weaving.

Standard: No net decrease in Practitioner usability of redbud and blue elderberry over baseline (from 2005 assessment), and no damage to plant species caused by visitor use. Results from 2006 monitoring of showy milkweed and bracken fern will serve as baseline data for these species. Quantitative standards will be set through continued consultation with practitioners.

Zones: Zone 2B Discovery, Zone 2C Day Use, Zone 2D Attraction

Sampling: As mentioned, monitoring of this indicator in 2006 focused on the practitioner assessment only. Practitioners conducted field assessments on various days during the Fall of 2006 according to traditional gathering practices. They assessed several of the representative plant species included in this monitoring effort. Assessments included the documentation of the number of usable stems or berry bunches per plant based on agreed upon traditional gathering criteria. The number of broken stems and/or berry bunches and the overall usability was also recorded for each plant visited. Overall usability assessments (ranged from “1” = lowest usability to “10” = highest usability) as shown in Table 2.5.1.

Table 2.5.1. Usability classes for “number of usable stems” and “number of broken usable stems”, from practitioner assessment of traditional plant resources.

Original practitioner count	Usability class
1-10	1
11-20	2
21-30	3
31-40	4
41-50	5
51-60	6
61-70	7
71-80	8
81-90	9
91-100+	10

Results: The following series of tables present the results from the practitioner assessments of the various plant species included in this monitoring effort in 2006. Table 2.5.2 presents the results of the practitioner assessments for the three blue elderberry plants. For elderberry plant #1 practitioner found more than 10 berry bunches for food; more than 5 stems suitable for clapper sticks, staves and fire drills; and 4 stems usable for flutes. Only 1 stem was found to be broken that would have otherwise been suitable for flutes. Overall usability ratings ranged from 5 to 7 for the various uses.

Elderberry #2 was assessed as having 4 usable stems for staves; 2 stems each for flutes and fire drills respectively; and no usable stems or berries for clapper sticks or food (Table 2.5.2b). Two usable stems for clapper sticks were found to be broken. Overall usability was rated “1” for all uses except for food, which received a “0” rating.

Practitioners assessed elderberry #3 as having 7 usable stems for clapper sticks and 4 stems suitable for fire drills only (Table 2.5.2c). No stems or berry bunches were reported broken. Overall usability ratings were scored “5” for clapper sticks and “2” for all other uses.

Table 2.5.2a. Practitioner assessment of Blue Elderberry plant #1.

Blue Elderberry #1			
Traditional uses / use criteria	**# of useable stems / berry bunches**	**# of broken usable stems/ berry bunches**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use 1 (stems): Clapper • 1½-3 inches in diameter • "Straight" shoot 12-24 inches • Pith greater than ½ diameter of stem	5 +	0	0 1 2 3 4 5 6 **7** 8 9 10
Traditional Use 2 (stems): Staves • ¾ inches in diameter • "Straight" shoot 6-12 inches • Pith greater than ½ diameter of stem	5 +	0	0 1 2 3 4 **5** 6 7 8 9 10
Traditional Use 3 (stems): Flutes • ½ inches in diameter • "Straight" shoot 6-18 inches • Pith greater than ½ diameter of stem	4	1	0 1 2 3 4 **5** 6 7 8 9 10
Traditional Use 4 (stems): Fire Drill • ½ inches in diameter • 2½-3 feet in length • Pith greater than ½ diameter of stem	5 +	0	0 1 2 3 4 **5** 6 7 8 9 10
Traditional Use 5 (berries): Food • Good taste	10+	0	0 1 2 3 4 5 6 **7** 8 9 10

Table 2.5.2b. Practitioner assessment of Blue Elderberry plant #2.

Blue Elderberry #2			
Traditional uses / use criteria	**# of useable stems / berry bunches**	**# of broken usable stems/ berry bunches**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use 1 (stems): Clapper • 1½-3 inches in diameter • "Straight" shoot 12-24 inches • Pith greater than ½ diameter of stem	0	2	0 **1** 2 3 4 5 6 7 8 9 10
Traditional Use 2 (stems): Staves • ¾ inches in diameter • "Straight" shoot 6-12 inches • Pith greater than ½ diameter of stem	4	0	0 **1** 2 3 4 5 6 7 8 9 10
Traditional Use 3 (stems): Flutes • ½ inches in diameter • "Straight" shoot 6-18 inches • Pith greater than ½ diameter of stem	2	0	0 **1** 2 3 4 5 6 7 8 9 10
Traditional Use 4 (stems): Fire Drill • ½ inches in diameter • 2½-3 feet in length • Pith greater than ½ diameter of stem	2	0	0 **1** 2 3 4 5 6 7 8 9 10
Traditional Use 5 (berries): Food • Good taste	0	NA	**0** 1 2 3 4 5 6 7 8 9 10

Table 2.5.2c. Practitioner assessment of Blue Elderberry plant #3.

Blue Elderberry #3			
Traditional uses / use criteria	**# of useable stems / berry bunches**	**# of broken usable stems/ berry bunches**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use 1 (stems): Clapper • 1½-3 inches in diameter • "Straight" shoot 12-24 inches • Pith greater than ½ diameter of stem	7	0	0 1 2 3 4 <u>5</u> 6 7 8 9 10
Traditional Use 2 (stems): Staves • ¾ inches in diameter • "Straight" shoot 6-12 inches • Pith greater than ½ diameter of stem	0	0	0 1 <u>2</u> 3 4 5 6 7 8 9 10
Traditional Use 3 (stems): Flutes • ½ inches in diameter • "Straight" shoot 6-18 inches • Pith greater than ½ diameter of stem	0	0	0 1 <u>2</u> 3 4 5 6 7 8 9 10
Traditional Use 4 (stems): Fire Drill • ½ inches in diameter • 2½-3 feet in length • Pith greater than ½ diameter of stem	4	0	0 1 <u>2</u> 3 4 5 6 7 8 9 10
Traditional Use 5 (berries): Food • Good taste	0	0	0 1 <u>2</u> 3 4 5 6 7 8 9 10

Practitioner assessments of redbud are presented in Table 2.5.3 below. Redbud #1 was found to have 12 usable stems; plant #2 had 0; and plant #3 had more than 35 stems suitable for basketry. No usable stems were found to be broken on the three redbud plants assessed. Redbud #3 received the highest overall usability rating at "8", followed by redbud #2 at a rating of "4"; and finally redbud #1 received a rating of "1".

Table 2.5.3. Practitioner assessment of Redbud plants.

Redbud #1			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Basketry • "Straight" shoot 6" – 6 ft. • Un-branched • Primary growth (first year's growth, new)	12	0	0 <u>1</u> 2 3 4 5 6 7 8 9 10
Redbud #2			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Basketry • "Straight" shoot 6" – 6 ft. • Un-branched • Primary growth (first year's growth, new)	0	0	0 1 2 3 <u>4</u> 5 6 7 8 9 10
Redbud #3			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Basketry • "Straight" shoot 6" – 6 ft. • Un-branched • Primary growth (first year's growth, new)	35 +	0	0 1 2 3 4 5 6 7 <u>8</u> 9 10

Table 2.5.4 presents the results of practitioner assessments of 4 representative showy milkweed plots. The reader will note that due to the fact that survey plots were used in these assessments, practitioners found it easier to calculate the # of useable stems with a percentage. Plot # 1 had 4% useable stems; plot #2 had 70%; plot #3 had 50%; and plot #4 0 stems suitable for cordage. Ten percent of the useable stems in plot #2 were found to be broken. Overall usability ranged from a rating of “7” for plot #2 to a “0” for plot #4.

Table 2.5.4. Results of practitioner assessment of Showy Milkweed plots in 2006.

Showy Milkweed Plot #1			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Cordage	4%	0	0 1 2 3 <u>4</u> 5 6 7 8 9 10
Showy Milkweed Plot #2			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Cordage	70%	10%	0 1 2 3 4 5 6 <u>7</u> 8 9 10
Showy Milkweed Plot #3			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Cordage	50%	NA	0 1 2 <u>3</u> 4 5 6 7 8 9 10
Showy Milkweed Plot #4			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Cordage	0	0	<u>0</u> 1 2 3 4 5 6 7 8 9 10

Table 2.5.5 presents the results of practitioner assessments of four representative bracken fern plots. Sixty percent of the stems in plot #1 were useable. More than 20 stems were found useable in plot #3. No information was recorded for plots #2 and #4 due to difficulty in accessing these areas. Plot # 3 received the highest overall usability rating at “8”, followed by plot #1 at “6”, plot #2 at “4”, and plot #4 at a rating of “2”.

Table 2.5.5. Results of practitioner assessment of Bracken Fern plots in 2006.

Bracken Fern Plot #1			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Cordage	**60%**	**20**	0 1 2 3 4 5 **6** 7 8 9 10
Bracken Fern Plot #2			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Cordage	**NA**	**NA**	0 1 2 3 **4** 5 6 7 8 9 10
Bracken Fern Plot #3			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Cordage	**20 +**	**0**	0 1 2 3 4 5 6 7 **8** 9 10
Bracken Fern Plot #4			
Traditional uses / use criteria	**# of useable stems**	**# of broken usable stems**	**Overall usability assessment for plot [0 = none, 1 = extremely poor, 10 = optimal]**
Traditional Use (stems): Cordage	**NA**	**NA**	0 1 **2** 3 4 5 6 7 8 9 10

Discussion: Similar to last year, emphasis was placed on maintaining relationships between Park personnel and the local American Indian community, with both parties dedicated to the importance of the traditional resources this indicator is striving to protect. Based on discussions at several meetings, including the 2005 fall workshop, and due to operational constraints it was decided that this year’s monitoring effort would focus on the practitioner assessment of the “usability” of various plants for traditional purposes. This decision reflects an emphasis on the ethnographic quality or cultural value of plant resources, rather than their biological condition. This approach seemed to be the most efficient and meaningful choice since the primary objectives of this indicator were based on monitoring the suitability of plant resources for traditional practitioner use, and scientific inquiry, although providing insightful information, was a relatively costly and indirect method of attempting to address these parameters.

Comparisons between 2005 and 2006 data revealed variation in usability of blue elderberry and redbud individuals (which isn’t surprising given the small sample size), and the following provides a synopsis of findings: Elderberry #1 displayed an overall increase in usability, but did, however, exhibit a slight increase in broken stems. Blue elderberry #2 exhibited an overall decrease in usability (although stems suitable for Staves, Flutes, and Fire Drills increased by 400%, 200%, and 100%, respectively), and exhibited the same number of broken stems/berry bunches as last year. Blue elderberry #3 also displayed and overall decrease in usability, although the amount of stems suitable for Clapper sticks increased by 700%.

Redbud usability generally increased overall, with numbers of usable stems increasing by over 1000% on redbud #1, and over 350% on redbud #3. Usability of redbud #2 did not exhibit any significant changes. As was the case in 2005, broken stems and damage appeared to be a minor issue for monitored plants (Tables 2.5.2a-c and 2.5.3).

Although variation between 2005 and 2006 data proved to be substantial, with both large increases and decreases in usability, it would be difficult at this point to attribute these changes to any one factor, including human impact. In fact, after scrutinizing these results, it seems unlikely that the decrease in usability observed in blue elderberry was caused by visitor impacts. This assertion is supported by the fact that the one elderberry individual that actually exhibited an increase in usability was the one that is located with in the closest proximity to high visitor use (adjacent to the trail near the parking lot at the Cascades Dam picnic parking area), while the other two individuals reside in less impacted areas. This increase may also have been caused by greater accessibility to blue elderberry #1 by the American Indian practitioners, therefore resulting in an unconscious bias. It was also interesting that, although usability decreased for two of the three blue elderberry individuals, the number of broken branches or berry bunches did not. This further suggests that factors other than direct human impact may have influenced between-year variation. These may have included annual variation in herbivory pressures, water and nutrient availability, and timing of monitoring. Also, although substantial efforts were made to standardize use criteria through intense consultation with practitioners, the results from practitioner assessments may still have inherent variability due to (1) the thoroughness with which the monitoring is conducted, (2) individual knowledge and/or unconscious bias of practitioner to certain material types, etc. Future monitoring will need to be carried out with consideration for these issues.

Data collection efforts also encountered logistical hurdles that affected results. The closing of Highway 140 due to the Ferguson Rockslide limited practitioner access to the Valley for a significant portion of the growing season. This prevented monitoring from occurring during the same timeframe as it did 2005, and it also limited the amount of data able to be collected in some cases (e.g. certain bracken fern and milkweed data). Lack of easy accessibility to plant populations in El Capitan meadow contributed to this as well.

In conclusion, the time and energy invested in 2005 and 2006 to pilot and develop this indicator seems to have paid off through the valuable inter-nation relationships that have been established and the lessons learned regarding the challenges of monitoring such an important resource. In 2007, the Park will continue striving to develop the most effective way of accomplishing this goal, which may focus on expanding the monitoring of traditional plant resources through construction of a geospatial dataset with help of American Indian practitioners that would be much broader in scope than what we have been able to address so far with this indicator.

2.6. WILDERNESS ENCOUNTERS

One of the components of the recreational Outstanding Remarkable Value for the Merced River Plan is the opportunity for solitude. Solitude has been an enduring characteristic of a Wilderness experience (Lucas 1964). The Wilderness Act of 1964 stipulates that areas designated as such provide outstanding opportunities for the enjoyment of solitude. The un-trailed zone (1A) trailed (1B) Wilderness zones of the Merced River should provide a high opportunity for solitude.

Expectations for solitude and actual numbers and types of groups encountered have been shown to have a significant effect on the quality of visitor experiences (Patterson and Hammitt 1990, Vaske et al. 1986, West 1982, Newman 2002). Encounters are also an excellent way to assess use levels and density, which can affect other Outstandingly Remarkable Values such as the biological, cultural, and scientific values set for the river corridor. For example, higher levels of use may result in compromised water quality.

Measurement: The number of encounters with other hiking parties on and off trails in Wilderness.

Standards: For trailed zones no more than one encounter with another party per hour 80% of the time.

Zones:

- 1B Trailed Travel

Sampling: Encounters were recorded by a National Park Service Ranger hiking or on horseback along trails. Monitoring was conducted as part of the Ranger's routine patrol of the backcountry along the Merced Lake corridor. Encounters were recorded onto index cards and entered into a database.

Sampling was conducted along trails in the upper Merced River corridor (Table 2.6.1). It is important to note that in 2006 only trails in zone 1B were monitored. The previous two years of data collection for off-trail encounters in zones 1A suggested that encounters were very infrequent in these areas. Also, considering the nature of hiking across country does not lend itself to encountering other hikers, and that it is time-consuming and in-efficient to gather data in remote areas of this kind, these areas were omitted from data collection this year. The three segments included in the analysis and presentation of results below include 1) Moraine Dome to Echo Valley, Echo Valley to Merced Lake Ranger Station, and 3) Merced Lake Ranger Station to Washburn Lake. These trail segments only were included in this analysis as they had a sufficient sample size from which to draw reliable conclusions.

Table 2.6.1. Wilderness Encounters Sampling Locations in 2006.

Wilderness Encounter Sampling Locations
1B Zone – Trailed Travel
Moraine Dome to Echo Valley
Echo Valley to Merced Lake Ranger Station
Merced Lake Ranger Station to Washburn Lake
Washburn Lake to Junction

Results: The following tables and graphs present the results of wilderness encounter monitoring in 2006. Table 2.6.6 shows the average encounter rates recorded along the three trail segments included in this monitoring effort. On average all three trail segments saw more than 1 encounter per hour. The Echo-MLRS segment received the highest encounter rate at 1.7 and the Moraine-Echo segment recorded the lowest at 1.1 encounters per hour. When considered against the standard of *no more than 1 encounter per hour, 80% of the time,* all three segments achieved this standard approximately 50% of the time.

Table 2.6.2. Wilderness encounter rates for specified trail segments in 2006.

Trail Segment	Average Encounters per Hour	Percent of Time (hours) Standard Met
Moraine-Echo	1.1	57%
Echo-MLRS	1.7	53%
MLRS-Washburn	1.5	45%

The following figures present encounter rates along the three trail segments. In these figures the percent of study hours or "time" is presented along the Y-axis, and average encounters per hour appear on the X-axis. Figure 2.6.1 shows encounter rates along the Moraine Dome to Echo Valley segment. Encounters were most commonly recorded at less than 1 per hour. However, approximately 5% of the sampling time encounters were recorded at between 2 and 3 per hour.

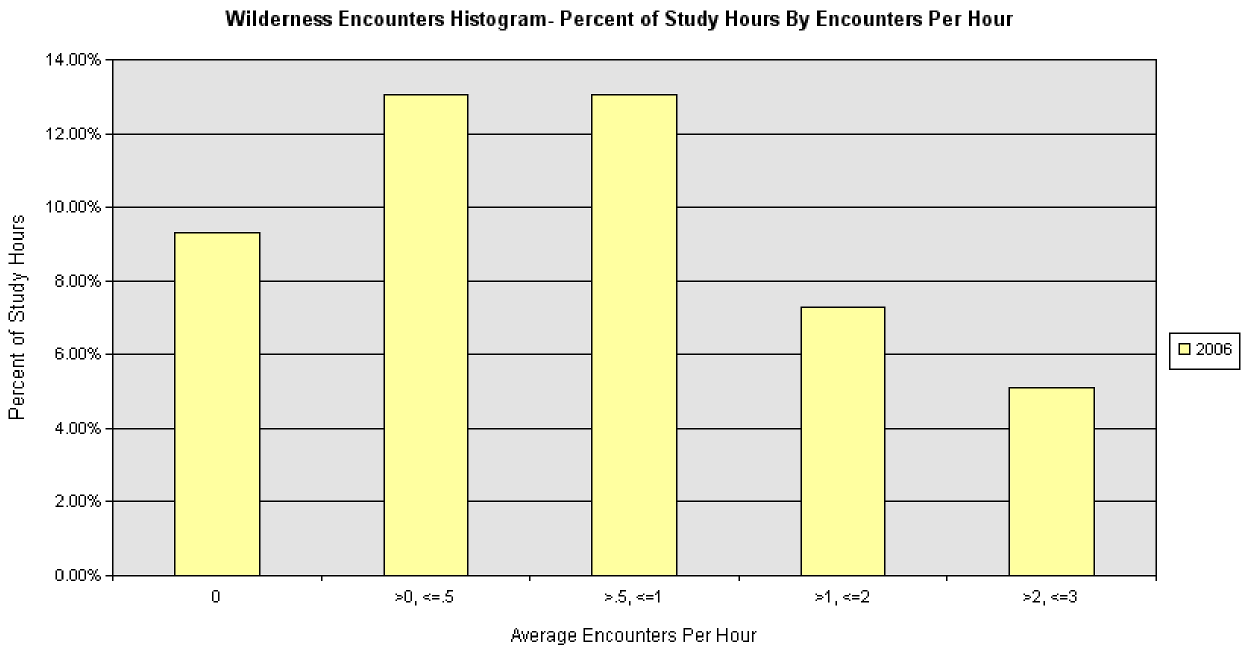


Figure 2.6.1. Encounter rates along the Moraine Dome to Echo Valley trail segment.

Figure 2.6.2 shows encounter rates along the Echo Valley to the Merced Lake Ranger Station segment. The majority of time along this segment encounters were recorded at a rate of 0 to 1 per hour. However, more than 4% of sampling time saw encounters at a rate of 3 groups or more per hour.

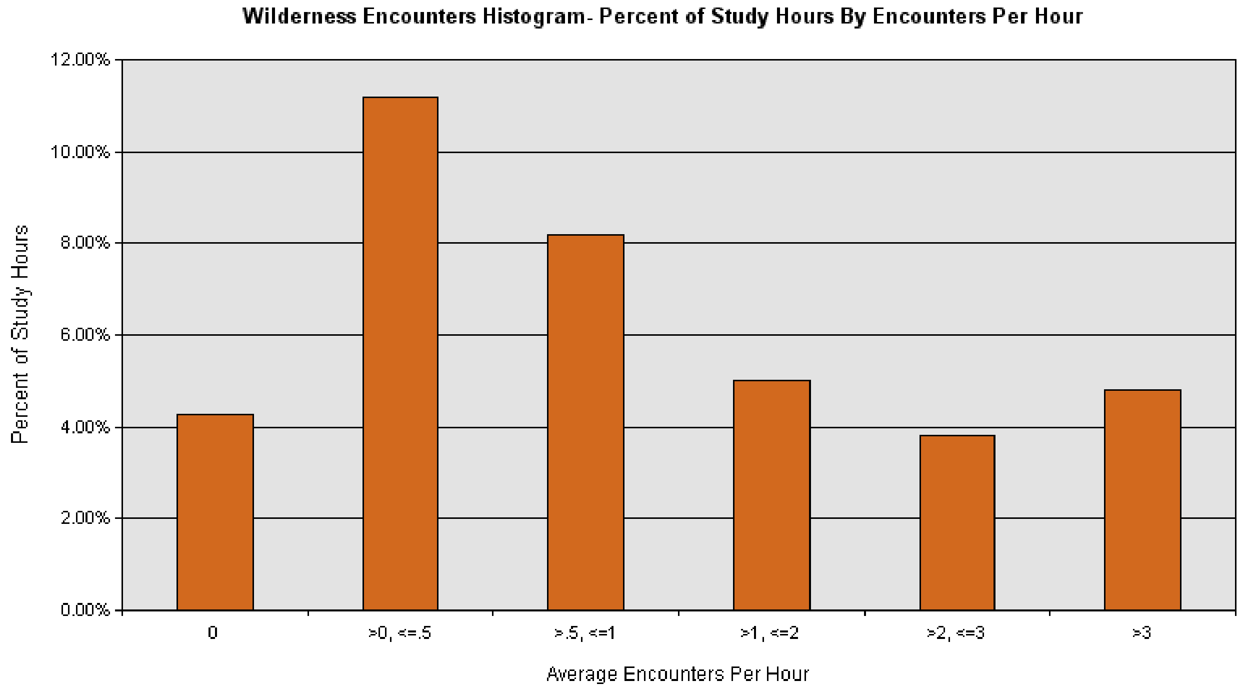


Figure 2.6.2. Encounter rates along the Echo Valley to Merced Lake Ranger Station trail segment.

Figure 2.6.3 shows encounter rates along the Merced Lake Ranger Station to Washburn Lake trail segment. Here encounters were most commonly recorded at a rate of between 0 and .5 per hour.

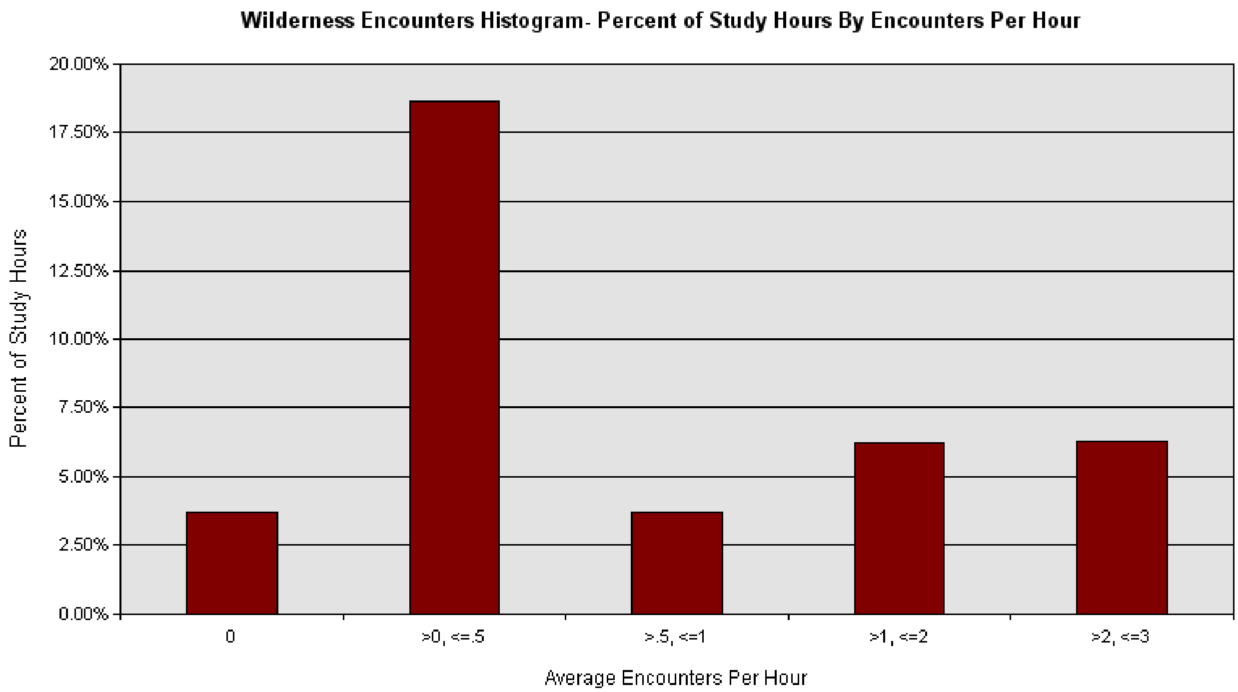


Figure 2.6.3. Encounter rates along the Merced Lake Ranger Station to Washburn Lake trail segment.

The following figures present encounter rates by date along the three trail segments. Figure 2.6.4 shows encounter rates by date along the Moraine Dome to Echo Valley segment. Average encounters were highest on 8/8 at 3 per hour. No encounters were recorded 9/24 or 9/27.

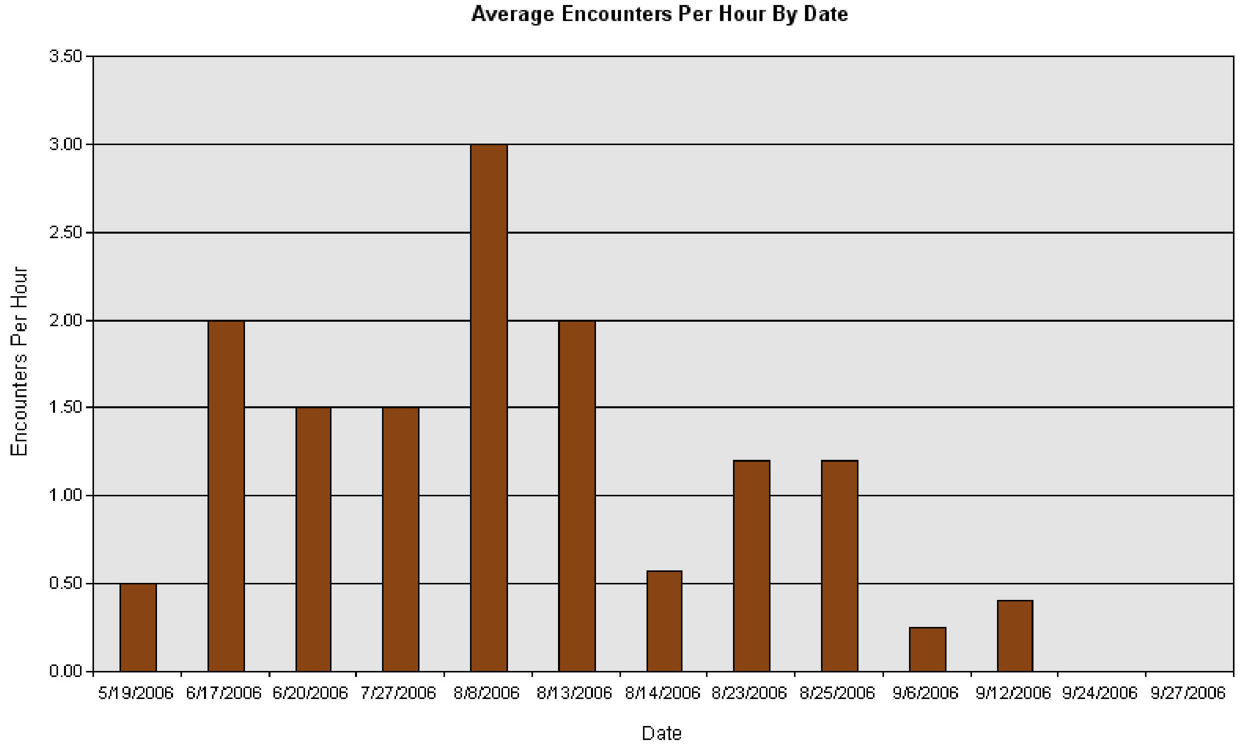


Figure 2.6.4. Encounter rates by date along the Moraine Dome to Echo Valley trail segment.

Figure 2.6.5 shows encounter rates by date along the Echo Valley to the Merced Lake Ranger Station segment. Encounter rates along this segment were highest on 8/25. No encounters were recorded on 7/30, 9/6, and 9/12.

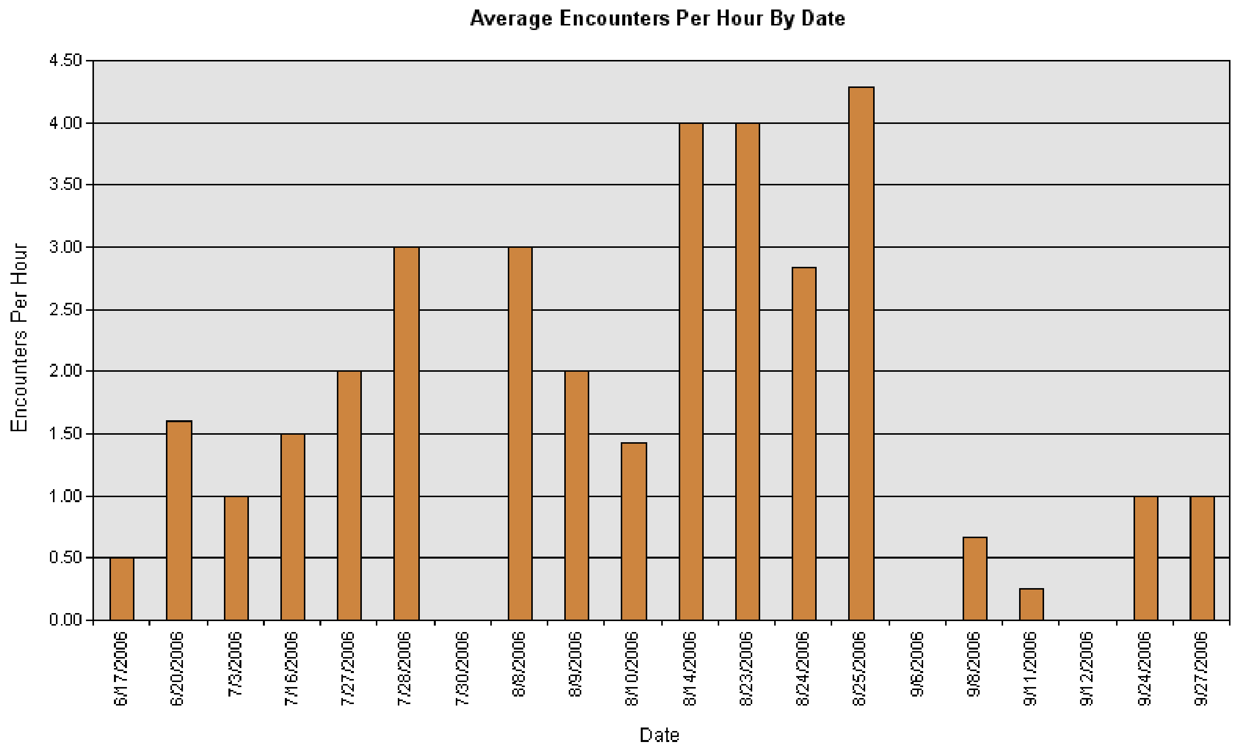


Figure 2.6.5. Encounter rates by date along the Echo Valley to Merced Lake Ranger Station trail segment.

Figure 2.6.6 shows encounter rates by date along the Merced Lake Ranger Station to Washburn Lake trail segment. For this segment encounters were highest on 8/12. No encounters were recorded on 9/25 or 9/26.

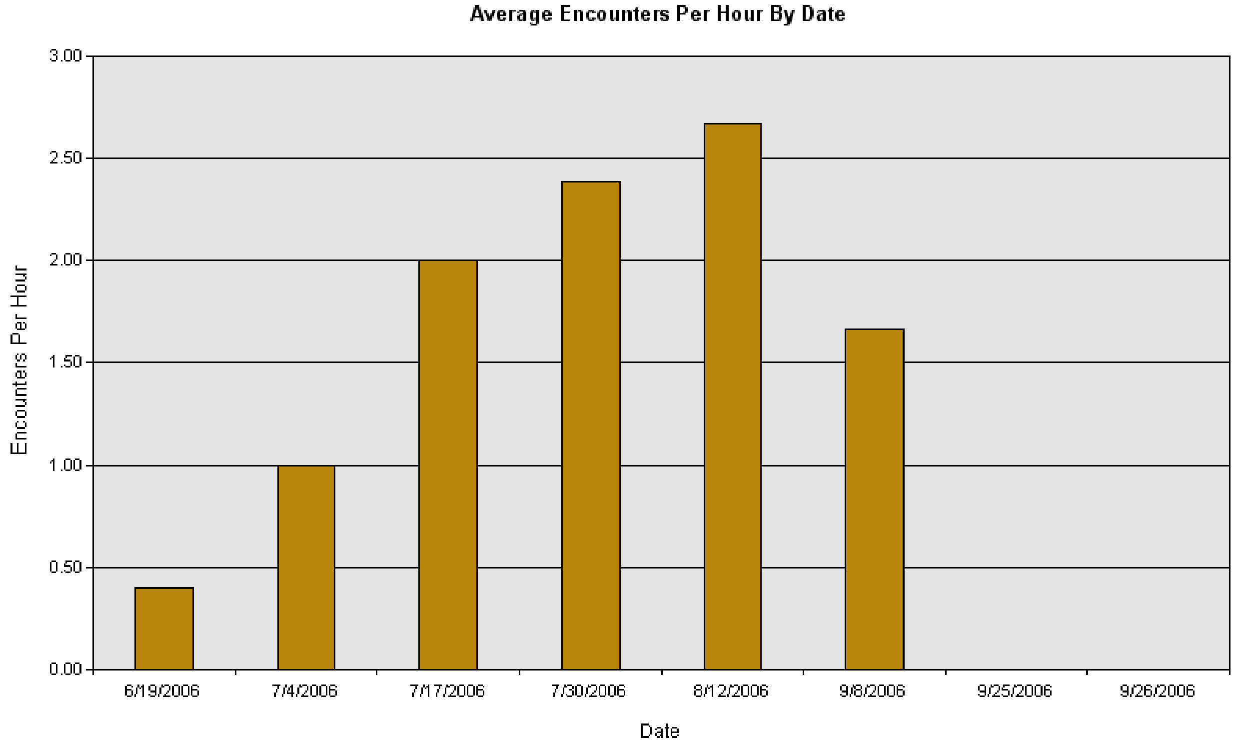


Figure 2.6.6. Encounter rates by date along the Merced Lake Ranger Station to Washburn Lake trail segment.

Discussion: Wilderness encounter monitoring in 2006 suggests that visitors frequently encounter more than 1 other party while hiking through the Merced Lake area of the river corridor. This includes the area from Moraine Dome to the Merced Lake Ranger Station a highly used travel corridor for hikers, backpackers, and stock users. Along this route lies the Merced Lake High Sierra Camp, a popular overnight destination. In 2005 the High Sierra Camps were not open due to late season snow conditions. Therefore, use levels appear significantly lower last year as compared to this year. However, caution should be taken when attempting to extrapolate these findings to a larger population. A small sample size and the number of sampling locations employed in this monitoring effort limit the robustness of these data. Continued monitoring is necessary in order to grow this dataset and improve its representativeness. More frequent counts conducted by Wilderness and other staff may provide a means to increase the sample size.

2.7. PEOPLE AT ONE TIME (PAOT)

Human use of parks can cause adverse impacts to both natural and cultural resources as well as the quality of desired visitor experiences (Hammitt and Cole 1998). Monitoring the number of people present in the Merced River corridor is important to managing and mitigating such adverse impacts as it provides information about the types and levels of visitor activity potentially causing impacts.

People At One Time (PAOT) is a visitor experience indicator that has been used at a variety of other parks and protected areas (Manning 1999, Manning et al. 1996, Manning et al. 1998) as well as in Yosemite (Manning et al. 1998, Manning et al. 1999, Newman 2002, Newman 2005). This indicator allows NPS managers to monitor the density of human use in a particular area. PAOT is a measure of the number of people present at any given moment in a particular location. For the Merced River PAOT monitoring serves as a "snap shot" of human use activity along the river. These snap shots reflect human use levels and behaviors that may potentially cause negative impacts such as crowding, user conflict, noise and others. PAOT data also serves as surrogate measures of overall human use in the river corridor further informing the protection of the Merced River's Outstandingly Remarkable Values.

Measurement: The number of people present at one time at selected attraction sites and along segments of trail and river.

Standard(s):

TRAILS: Zone 1C **-** Not more than 20 people on a 50-meter section of the trail at any one time, 80% of the time.

RIVER: Zones 2A, 2A+, 2B, 2C, and 2D **–** Additional research and data collection will be conducted this year that will be used to inform the establishment of appropriate standards of quality.

ATTRACTION SITES: Revised data collection efforts this year will be used to inform the establishment of appropriate standards of quality.

Zones:
- 1C Heavy Use Trail
- 2A Open Space
- 2A+ Undeveloped Open Space
- 2B Discovery
- 2C Day Use
- 2D Attraction

Sampling: A stratified sampling methodology was used to obtain a representative sample of visitor use across the days of the week during peak season from June to September. Sampling locations varied to include a segment of highly used trail and attraction sites, and three representative sites along the river. For trail and river sampling the number of people present within a 50-meter section of the trail or river was recorded at one-minute intervals for a period of 60 minutes or 1 hour. Counting periods were also stratified by time of day between 8:00 a.m. and 5:00 p.m. (Table 2.7.1). For attraction sites, counts were similarly conducted, though they were collected using a roaming rather than linear counting method due to the character of the areas under observation.

Finally, the number of people was recorded by activity type depending on location. Activities on trails included hiking, backpacking and stock use. Activities on the river included floating, fishing, swimming, walking, and other. For attraction sites the number of people, the number of vehicles, and the number of available picnic tables were recorded. For all PAOT counts observational codes were recorded documenting visitor behaviors including noise, litter or trash, large group activity, off-trail use, and user conflicts.

Table 2.7.1. PAOT stratified sampling counts.

Sample Period	Number of One Minute Counts
Weekday Morning	360
Weekday Afternoon	360
Weekend Morning	360
Weekend Afternoon	360
Holiday Weekday Morning	60
Holiday Weekday Afternoon	60
Holiday Weekend Morning	60
Holiday Weekend Afternoon	60

Results: The following set of figures present PAOT monitoring results for the various sampling locations in 2006. Each graph contains a breadth of information including the average PAOT by time of day, the maximum recorded PAOT by time of day, the distribution of user types recorded by time of day, and the average number of observational counts conducted by time of day. Figure 2.7.1 shows average PAOT along the river at the high use sampling site. In general, average PAOT along the river peaked in the afternoon between 1:00 and 6:00 p.m. The highest average PAOT was 17 with the maximum PAOT recorded overall being 50. Floating, swimming, and walking were the most documented uses along the river at this sampling site, while fishing was the least documented.

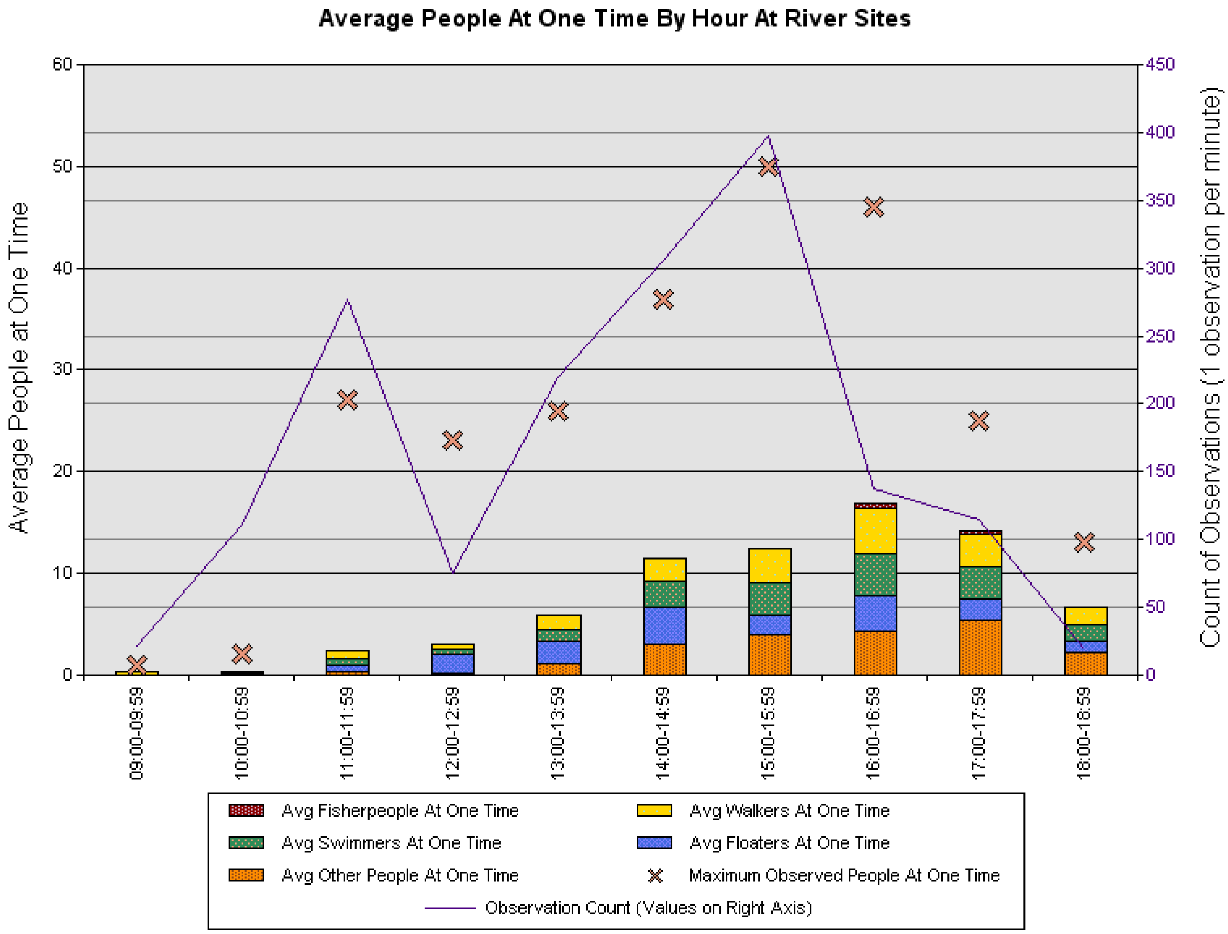


Figure 2.7.1. Average PAOT along the river at high use sampling site 2006.

Figure 2.7.2 shows average PAOT along the river at the medium use sampling site. Average PAOT along the river at this site peaked in the afternoon between 2:00 and 4:00 p.m. The highest average PAOT was 7 with the maximum PAOT recorded overall being 32. Swimming and walking were the most frequently documented uses along the river at this sampling site, while fishing was the least documented.

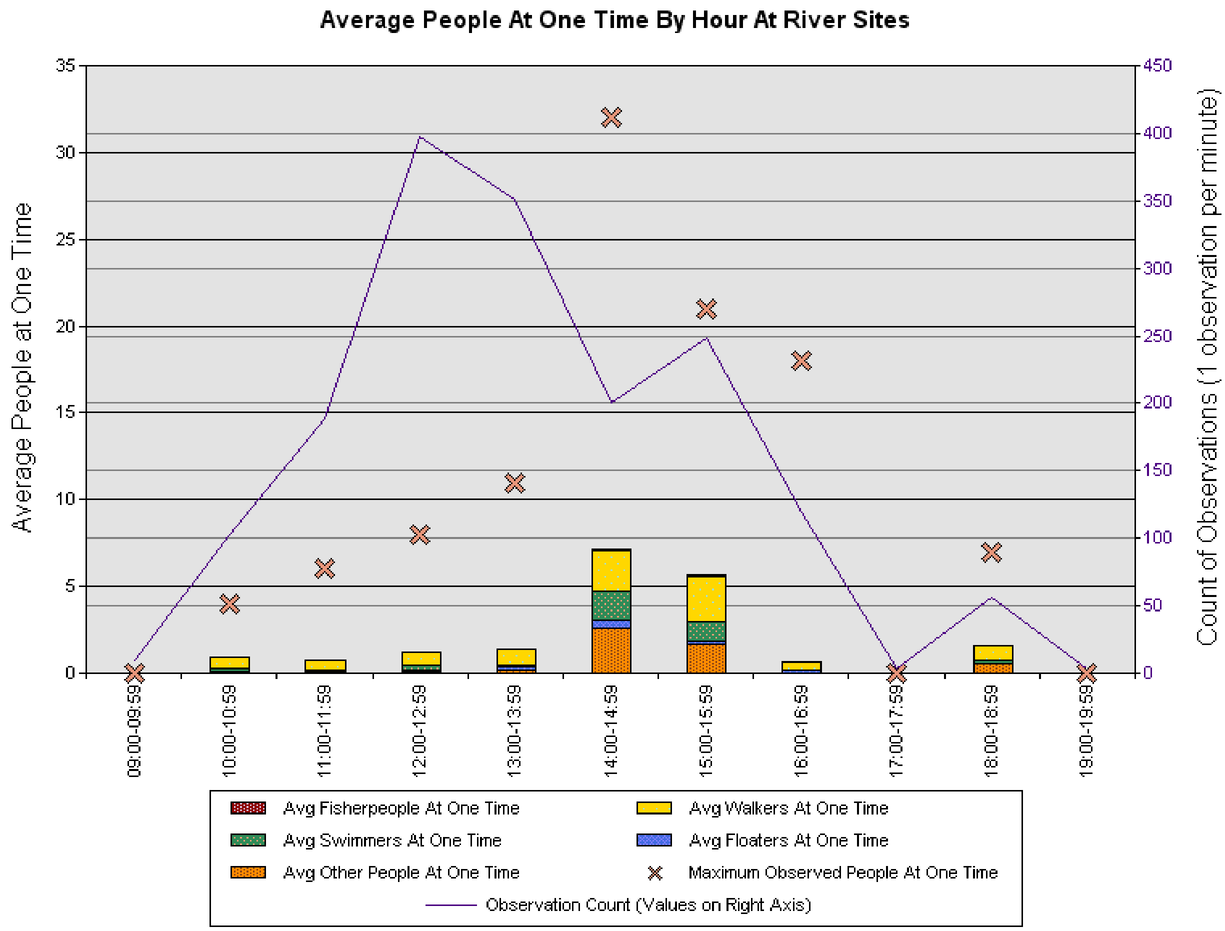


Figure 2.7.2. Average PAOT along the river at medium use sampling site 2006.

Figure 2.7.3 shows average PAOT along the river at the low use sampling site. At this site average PAOT along the river peaked between 1:00 and 5:00 p.m. The highest average PAOT was 3 with the maximum PAOT recorded overall being 17. Again, swimming and walking were the most documented uses along the river at this sampling site, while fishing was the least documented.

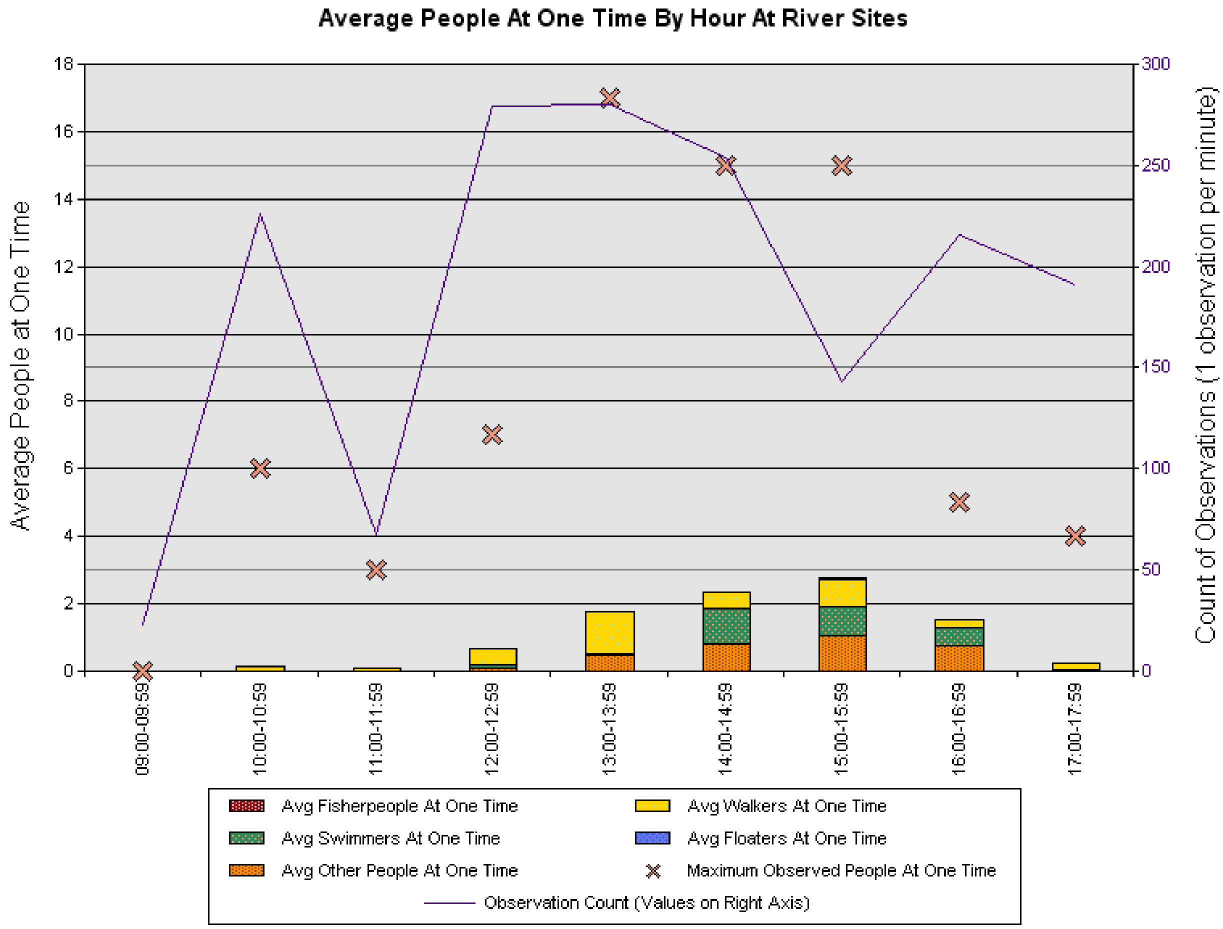


Figure 2.7.3. Average PAOT along the river at low use sampling site 2006.

Figure 2.7.4 shows average PAOT at the Sentinel Beach picnic area for 2006. Use at this site was relatively consistent between 12:00 and 6:00 p.m. in the afternoon. Average PAOT peaked at 77 with the maximum recorded PAOT of 243. Average vehicles at one time (VOT) showed a similar pattern of use throughout the day and peaked between 1:00 and 2:00 p.m. at 21 vehicles. No buses were recorded at this site.

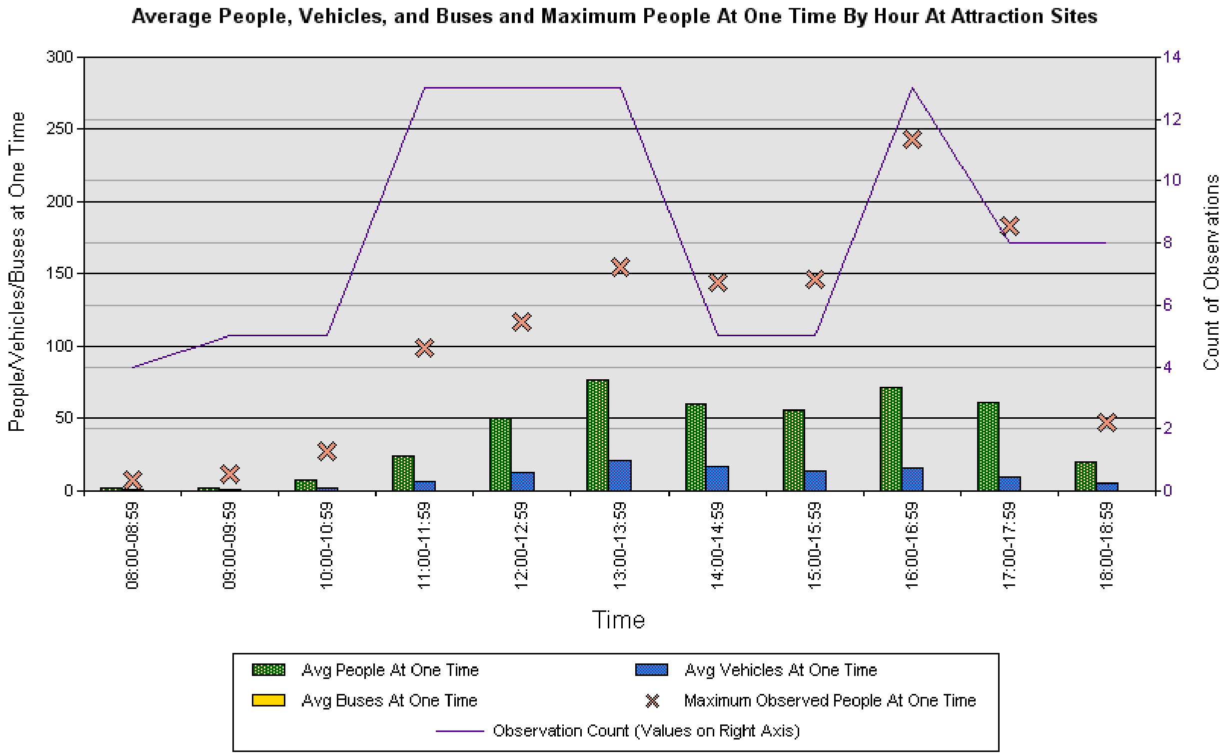


Figure 2.7.4. Average PAOT at attraction sites – Sentinel Beach 2006.

Figure 2.7.5 shows average PAOT at the Cascades picnic area in 2006. Use at this site was relatively consistent and sustained throughout the day with an extended range of visitation ranging from 8:00 a.m. to 6:00 p.m. Average PAOT peaked at 29 between 1:00 and 2:00 p.m. with the maximum recorded PAOT of 73 during that same hour. Average vehicles at one time (VOT) showed a similar pattern of use throughout the day peaking between 1:00 and 2:00 p.m. at 10 vehicles. No buses were recorded at this site.

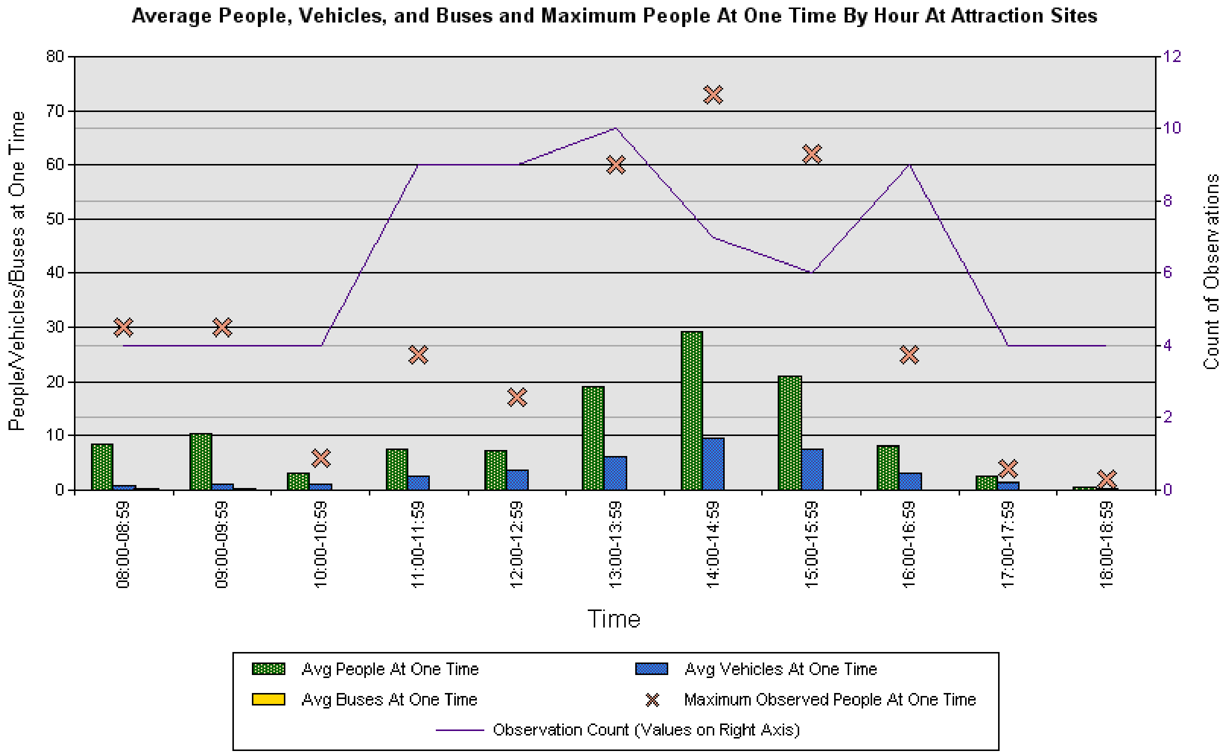


Figure 2.7.5. Average PAOT attraction sites – Cascades Picnic Area 2006.

Figure 2.7.6 shows average PAOT at the Texas Flat picnic area for 2006. Use at this site was relatively consistent as well, peaking during the 1:00 p.m. hour at 28 PAOT. The maximum PAOT recorded was 56 occurring between 4:00 and 5:00 p.m. in the afternoon. Average vehicles at one time (VOT) showed a similar pattern of use throughout the day and peaked between 1:00 and 2:00 p.m. at 10 vehicles. No buses were recorded at this site.

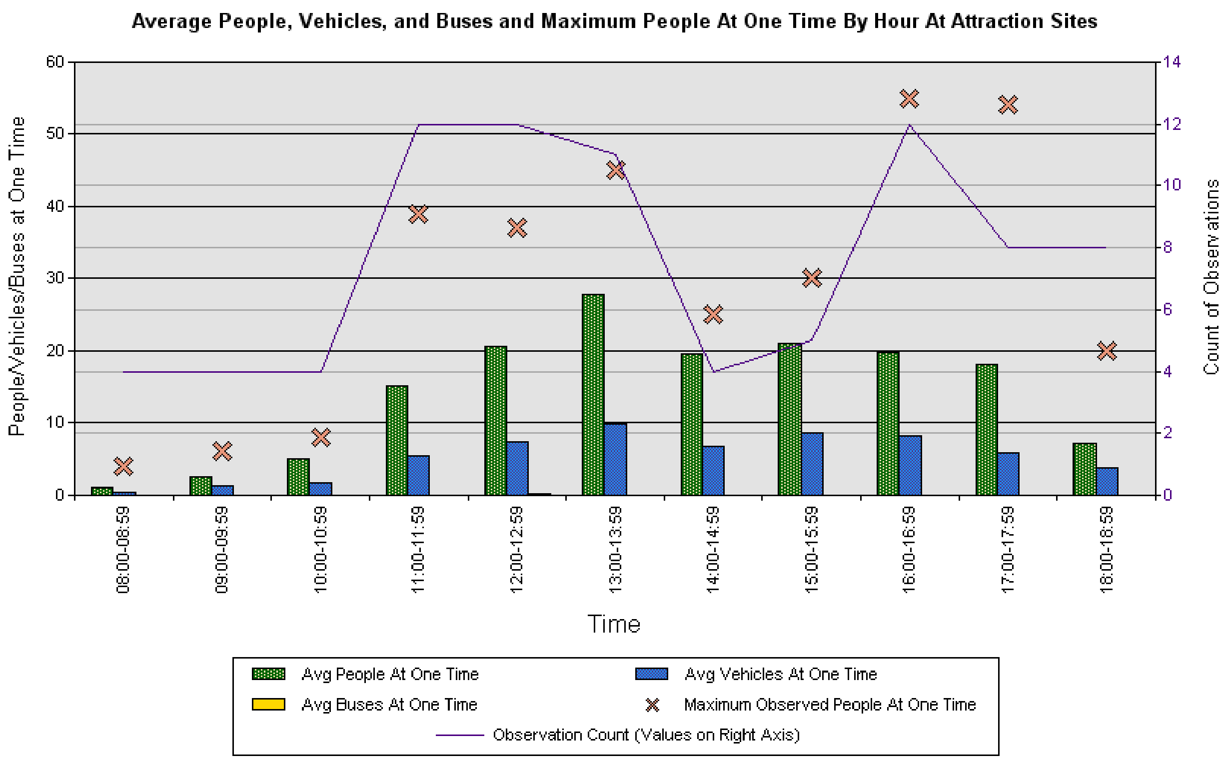


Figure 2.7.6. Average PAOT at attraction sites – Texas Flat Picnic Area 2006.

Figure 2.7.7 below shows the average PAOT along the trail to Vernal Falls in 2006. Use along this trail was relatively consistent throughout the day peaking during the 12:00 p.m. hour at 16 PAOT. The maximum PAOT recorded was 38 occurring twice during the 10:00 a.m. and 12:00 p.m. hours respectively. Hikers were overwhelming the most observed type of user along the trail. No stock users were observed.

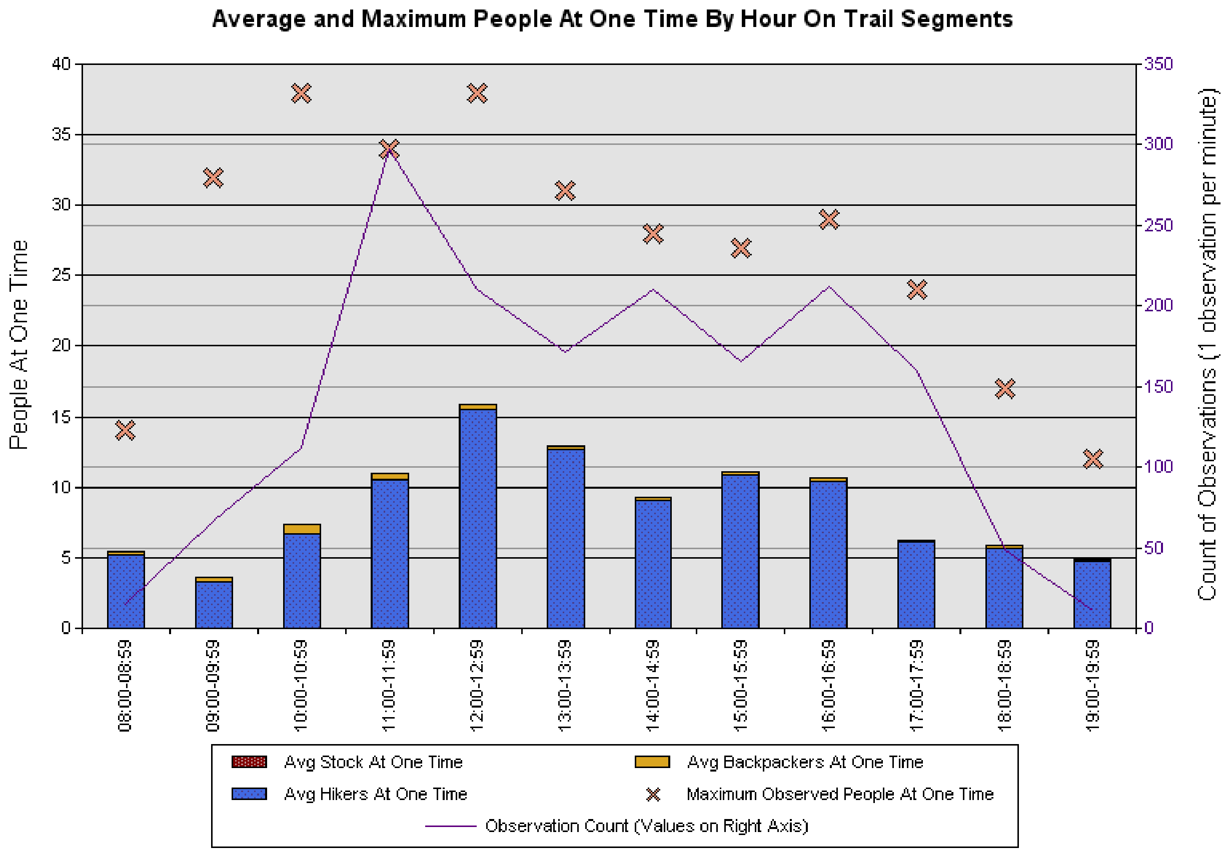


Figure 2.7.7. Average PAOT along high use trail segment in 2006.

Figure 2.7.8 below presents the average PAOT trail against the standard of no more than 20 PAOT, 80% of the time. Average PAOT was under 20 people the majority of the time at this sampling site. However, average PAOT exceeded 20 people 24% (only 76% compliance) of the time during the 12:00 – 1:00 p.m. hour.

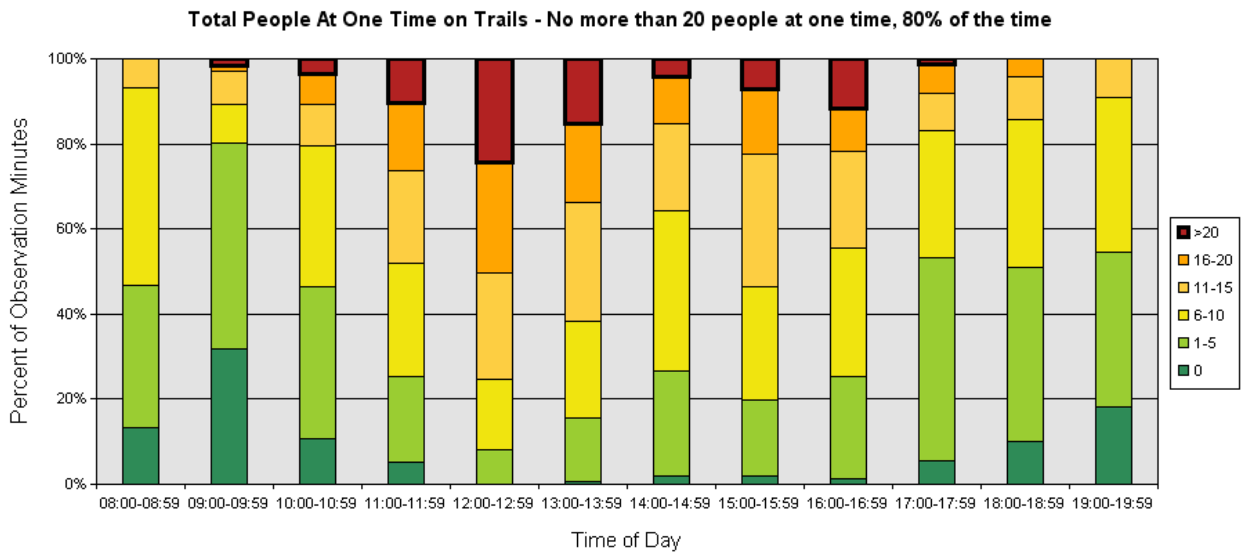


Figure 2.7.8. PAOT on trails, against the standard – No more than 20 PAOT, 80% of the time.

Finally, in 2006 observed visitor use behaviors during PAOT monitoring were recorded. Table X presents the behavioral codes used in this effort. A variety of use behaviors were documented most common of which were litter or trash, large group activity, and noise. Litter or trash was most prevalent at the low use river site. In particular, toilet paper was commonly found as this area is located near a pull-out and secluded from view. Other litter included articles of clothing and picnicking paraphernalia left behind. Visitor noise was most often heard at the high use river site and included the sounds of children playing. Large groups and off-trail use were most commonly observed during PAOT trail monitoring. Trash / litter and large group behaviors were also documented at the attraction site sampling locations.

Table 2.7.2. Visitor use behavioral codes used for PAOT monitoring in 2006.

PAOT Behavioral Codes
(A) Large group
(B) Noise
(C) Litter / trash
(D) User conflicts
(E) Off-trail Use (please specify)
(F) Other (please specify)

Discussion: PAOT is most effectively understood as a measure of visitor use density. Monitoring of this indicator at various locations in the river corridor and across several activity types suggests that visitor use density fluctuates across time. Not surprisingly use density is at its highest during overall peak use periods – in the afternoon between mid-day to late afternoon and on weekends and holidays.

Visitor use also varies by location, concentrating in certain places during the above mentioned times. Therefore, the sampling locations included in this monitoring effort were chosen to represent key use areas or attraction sites. As such these areas reflect concentrations of visitor use or what one might consider “pressure points” for visitor use levels and corresponding use densities. Sampling sites were also chosen to be inclusive of the variety of settings where use occurs along the river corridor including river segments, trails, and day use areas. Additional sampling sites may be incorporated into this monitoring effort in the future as operational efficiencies increase. This would ensure that PAOT monitoring address all key pressure points and that the data continues to be representative of overall peak visitor use within the river corridor.

Finally, observational data suggests, at least anecdotally, several issues related to visitor use behavior that may be addressed. Litter / trash and large group activity were often observed. These issues should be addressed on a site-by-site, case-by-case basis as the details of their occurrence are likely to vary according to the particular context of their occurrence. For example, the litter at the low use river monitoring site consisted of primarily toilet paper. A sign informing visitors of the nearest bathroom facility placed at the roadside pull-out may be an appropriate way to address this issue. However, at the high use river site, clothing articles and picnicking paraphernalia were left behind as litter or trash. Here a “leave-no-trace” message may be appropriate. Large group activity was often noted, however, the extent to which this behavior affected visitor experiences and resources is uncertain based on the monitoring of this indicator.

2.8. PARKING AVAILABILITY

Transportation has long played an important role in the National Park System (Percival 1999). Transportation issues have recently been studied at such parks as Yellowstone (Mings et al. 1992), Smoky Mountains (Sims et al. 2005), Blue Ridge Parkway (Vallier et al. 2003) as well as in Yosemite (Nelson and Tumlin 2000, YOSE 1999, White et al. 2006).

The vast majority of visitors to Yosemite arrive in private vehicles, and more than a million vehicles enter Yosemite Valley each year, resulting in significant traffic congestion. Traffic congestion can cause a variety of impacts to the Merced River's Outstandingly Remarkable Values including the natural and cultural resources as well as the quality of the visitor experience. Specific impacts include increased travel and waiting times, wildlife depredation, air pollution, noise, vegetation loss, and others. Therefore, an indicator was piloted in 2005 measuring the availability of parking facilities at the day use parking area. Parking availability serves as an indicator of overall traffic congestion in Yosemite Valley and, therefore, serves as an early warning sign suggestive of the extent to which the Merced River's Outstandingly Remarkable Values are affected by human vehicular use.

Measurement: Number of times (instances) each month the Camp 6 day use parking area filled to capacity and alternative parking measures were implemented.

Standards: Standards have not been established for this indicator at this time. On-going monitoring efforts will provide needed baseline data from which to set standards.

Zones:
- 2A Open Space
- 2B Discovery
- 2C Day Use
- 2D Attraction
- 3A Camping
- 3B Visitor Base and Lodging
- 3C Park Operations and Administration

Sampling: Park Rangers responsible for managing day use parking kept a daily log of information pertinent to this indicator. On days when parking reached capacity and the lot was closed, parking staff circulated the lot conducting a count of vehicles on the ground (VOG) at the time of closure. The time the lot closed and re-opened were also recorded.

Results: The day use parking area closed a total of 28 times during the summer of 2006 (Table 2.8.1). Closures occurred between the months of May and October, between the Memorial Day and Labor Day holidays. The reader should note that on two occasions the lot closed twice in a single day. However, only the first closure of the day was included in this analysis. The month of August saw the highest number of lot closures at 13. On average the lot was closed 2.5 hours on each occasion, and the average number of VOG at the time of closure was approximately 790.

Table 2.8.1. Summary data for parking capacity indicator in 2006.

VARIABLE	RESULT
Total number of closures	28
Average duration (hours) of closures	2.5
Average number of Vehicles On the Ground (VOG) at time of closure	790

Figure 2.8.1 below shows the total number of VOG at the time of each of the 28 lot closures in 2006. On one occasion the lot reached a capacity of over 900 vehicles, and on eight other occasions the lot reached a capacity of more than 800.

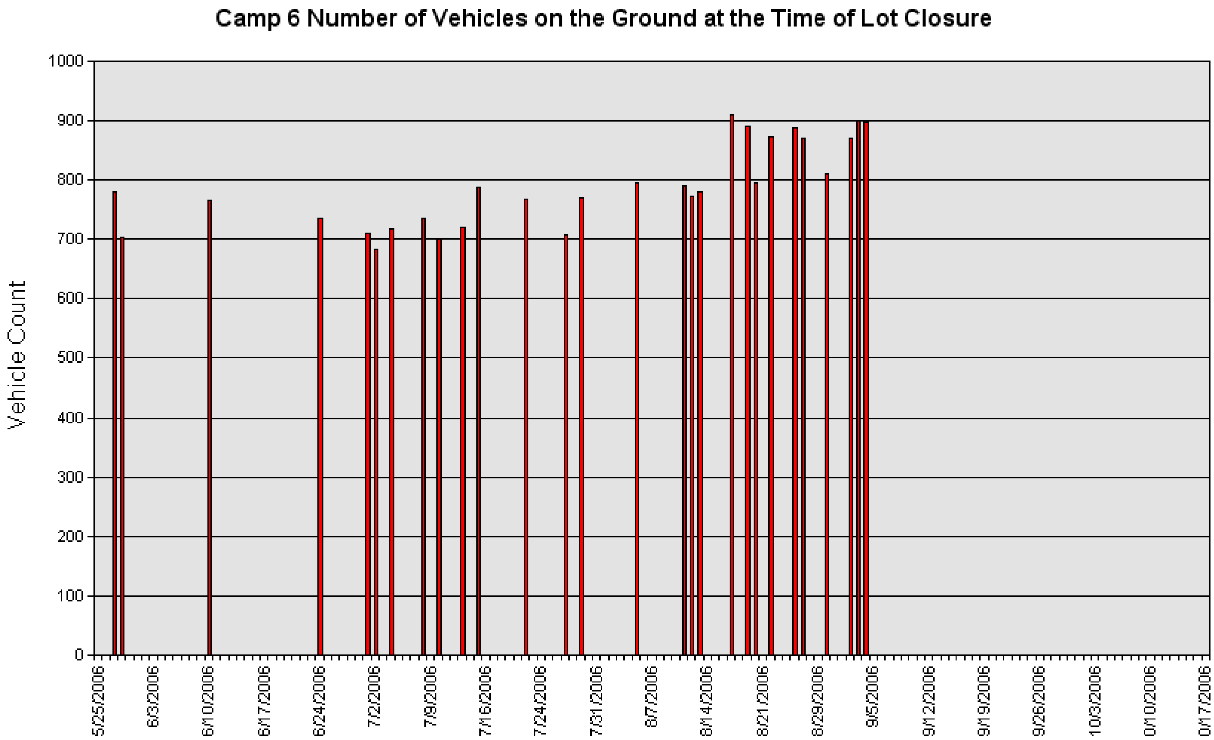


Figure 2.8.1. Vehicles on the Ground (VOG) at time of lot closures in 2006.

The following graph (figure 2.8.2) shows the time and duration of each of the 28 closures. In general, all closures occurred in the afternoon between 12:00 p.m. and 5:00 p.m. The earliest recorded closure time was 11:30 a.m. and the latest recorded re-opening time was 5:00 p.m.

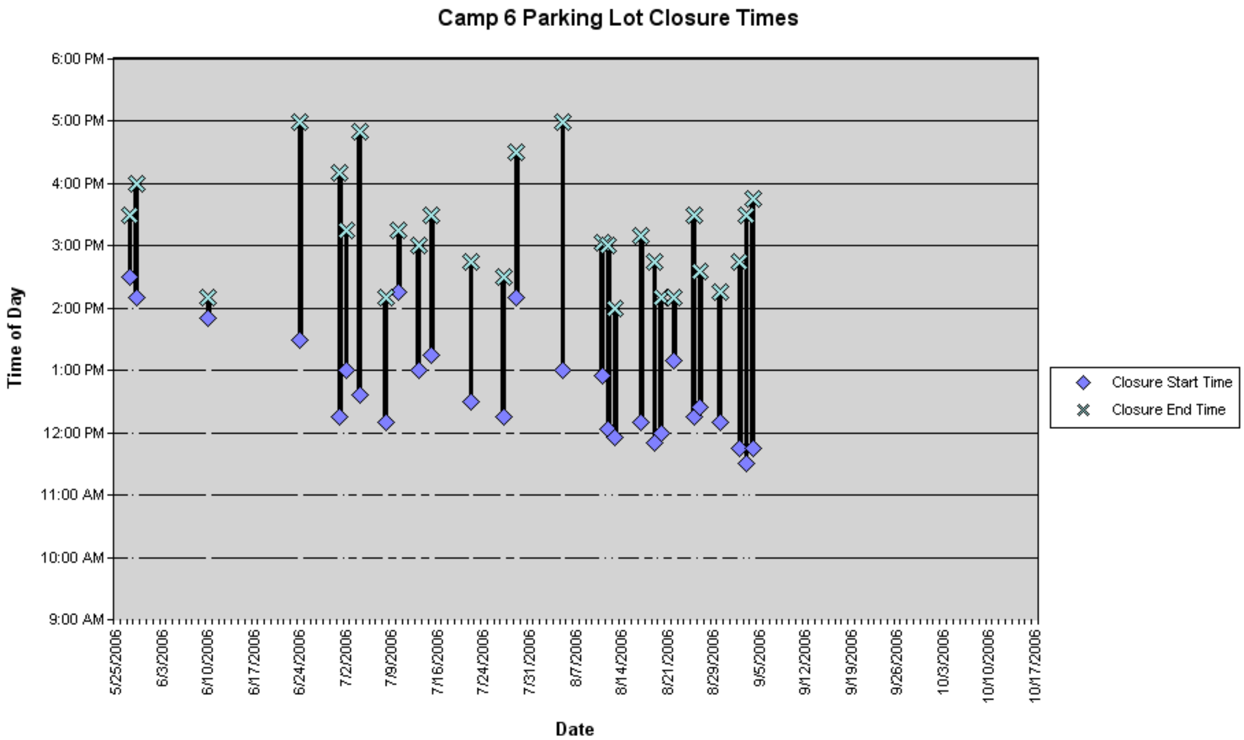


Figure 2.8.2. Time and duration of lot closures in 2006.

Discussion: To begin this discussion it is important to emphasize that 2006 was an anomalous year for traffic flows into Yosemite Valley due to the Fergusson Rockslide and corresponding closure of Highway 140. Anecdotally, traffic management staff noted that the day use area was busier at a later point during each day, most likely due to the additional travel time day users arriving from areas west of the park needed to enter the park via Highway 41 or Highway 120.

Due to methodological improvements in the monitoring of this indicator it is difficult to make comparisons between 2005 and 2006 data. Nevertheless, it appears that the overall frequency of day use parking lot closures was significantly lower in 2006 from the previous year. Last year the lot filled to capacity and closed on more than 90 occasions, nearly half the days of each month during the peak season. Overall, visitor use levels were similar in both years suggesting other issues may have affected this trend other than overall use levels.

2006 was the second year of implementation of an innovative traffic management program. This program includes the hiring of key traffic management staff who direct parking at the day use lot. It also includes the implementation of strategies such as rotating areas within parking areas, providing signs, and other management techniques to affect traffic flows and parking capacity. The effective implementation of this program may have reduced the number of closures of the day use lot due to more efficient use of the space. This point is evidenced in the total number of vehicles on the ground that the area accommodated at the time of closure. On most occasions the lot reached a capacity of approximately 800 vehicles before it was closed. This is an increase from last year where the lot was closed often at levels as low

500 vehicles. Caution should be taken, however, when considering this as this monitoring effort did not take into consideration the actual footprint occupied by parked vehicles from year to year. Nevertheless, the traffic manager suggests that the space used for parking has not changed significantly from last year.

Therefore, in summary, the data presented here reflects the fact that the total number of vehicles that may be accommodated at the day use parking facility varies (see Figure 2.8.1 above). Attributes that contribute to this variance may include vehicle type, weather, and whether parking is directed (i.e., traffic management staff guide where and how visitors park in the allotted space) or whether it is not directed. This situation is most likely attenuated by the lack of formalization of the area. In the absence of well-designed and designated parking spaces, and left to their own auspices, visitors will use the space less efficiently than in a more formalized setting that is actively managed.

3. PROGRAM EVALUATION

The monitoring of indicator variables as described in this document is part of an on-going program to ensure the quality of park resources and visitor experiences. As mentioned earlier in this report, VERP is a planning and management process that focuses on visitor use. The VERP Handbook (NPS 1997) suggests that, "visitor use management begins with a plan, but it continues as a cyclical process involving monitoring, evaluation, and taking action to make adjustments." Monitoring is essential to "close the loop" in this overall process and ultimately inform management actions. Evaluative measures are, therefore, essential to continued VERP monitoring program development and implementation, and to ensure that this program is indeed effective.

Toward this end two workshops were held, one in the spring and another in the fall of 2006, to evaluate and improve upon the VERP monitoring program for the Merced River corridor. The following section presents the results from these workshops. Overall, VERP monitoring program development is expected to be continuous as described in the Handbook. However, it has been recognized that efforts to initiate the program will require more rigorous evaluation and analysis. For this reason, the workshop format has been employed in this the third year since the program's inception. This format is likely to continue in subsequent years until which time the program has been well established.

3.1. SPRING WORKSHOP

A two-day workshop was held on April 17th and 18th, 2006 in Yosemite Valley to evaluate the VERP monitoring program. The objective of this workshop was to refine indicators and standards from the 2005 field season, and to coordinate and initiate efforts for the upcoming field season. This workshop was attended by various park service personnel and researchers from cooperating universities.

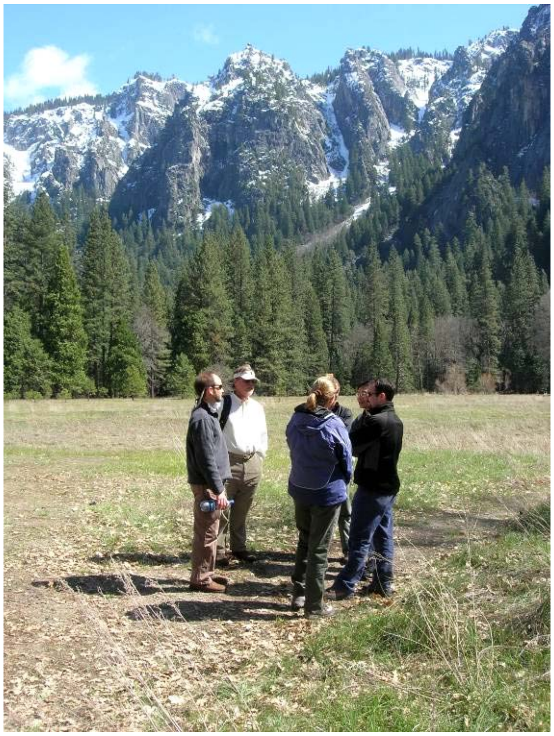


Figure 3.1.1. Work group discussing visitor use and social trail monitoring in El Cap Meadow 2006.

The first day of the workshop was a field day in which participants broke up into separate work groups according to the indicator variables they work with. Each indicator work group visited a sampling site pertinent to their work and engaged in a series of discussions regarding indicator monitoring, including troubleshooting data collection issues, identifying alternative sampling strategies and sampling locations, addressing field logistics and constraints, etc.

On the second day of the workshop participants met for a round-table discussion focused on programmatic and individual indicator evaluation. Here changes to monitoring protocols were discussed in more detail in preparation for the field data collection effort.

The workshop concluded with an awards ceremony acknowledging the efforts of individuals integral to the monitoring program.

3.2. FALL WORKSHOP

A second workshop was held on October 23 and 24, 2006 at the Clark Community Hall in El Portal. Park personnel, cooperating university researchers and other individuals associated with the VERP monitoring program attended the workshop.

Figure 3.2.1. Cooperating researcher presents results from his work.

This workshop kicked-off with an activity to identify the successes of the VERP monitoring program during 2006. Significant achievements of the program identified in this activity were:

- Completed pilot monitoring effort on Half Dome.
- Made significant improvements to indicator variables.
- Improved the implementation of wilderness encounter monitoring.
- Converting some long standing databases (i.e. ASMIS) into VERP format.
- Inspected over 35,000 vehicles for food storage violations as part of the wildlife indicator.
- Compiled past data.
- Initiated soundscapes work.
- Achieved greater coordination and teamwork.
- Began using PDAs for better field Water Quality data collection.
- Worked with 2 Student Conservation Association workers and many volunteers.
- Improved rigor of science-based data gathering methods.
- Hired new seasonal monitoring program assistant coordinator.
- Development o draft protocol to address human impacts to archeological resources.
- Conducted extensive analysis on wildlife data.
- Expanded riverbank erosion indicator to detailed cross-sectional assessments.
- Worked with “sister park” in China to share knowledge of monitor protocols.
- Progression of indicators that address inventory methods to more sampling-based methods.
- Counted on the leadership of staff in vegetation and restoration branch.
- Added caffeine sampling to water quality monitoring.
- Successfully coordinated data collection in multiple sampling sites.
- Measured multiple facets of visitor use and its effects on resources.
- Monitoring program has become an adaptable learning process.
- Beginning to pull databases together from paper process to electronic version.

The workgroup then moved into an activity to brainstorm recommendations for improving the VERP monitoring program overall. Suggestions that came out of this exercise were as follows:

- Limit the number of indicators - make them sustainable within daily park operations.
- Use data to inform management actions.
- Analyze visitor behavior and residual effects of our actions and recommendations before we move forward.
- Should tie standards of quality to available research to the extent possible.
- Need to hire additional staff. Completed pilot monitoring effort on Half Dome.
- Made significant improvements to indicator variables.
- Improved the implementation of wilderness encounter monitoring.
- Converting some long standing databases (i.e. ASMIS) into VERP format.
- Inspected over 35,000 vehicles for food storage violations as part of the wildlife indicator.
- Compiled past data.
- Initiated soundscapes work.
- Achieved greater coordination and teamwork.
- Began using PDAs for better field Water Quality data collection.
- Worked with 2 Student Conservation Association workers and many volunteers.
- Improved rigor of science-based data gathering methods.
- Hired new seasonal monitoring program assistant coordinator.
- Development o draft protocol to address human impacts to archeological resources.
- Conducted extensive analysis on wildlife data.
- Expanded riverbank erosion indicator to detailed cross-sectional assessments.
- Worked with “sister park” in China to share knowledge of monitor protocols.
- Progression of indicators that address inventory methods to more sampling-based methods.

- Counted on the leadership of staff in vegetation and restoration branch.
- Added caffeine sampling to water quality monitoring.
- Successfully coordinated data collection in multiple sampling sites.
- Measured multiple facets of visitor use and its effects on resources.
- Monitoring program has become an adaptable learning process.
- Beginning to pull databases together from paper process to electronic version.
- Limit the number of indicators - make them sustainable within daily park operations.
- Use data to inform management actions.
- Analyze visitor behavior
- Need to really discuss standards in more detail.
- More research on specific indicator variables.
- Explore what other parks/units are doing. What are their results?
- Conduct research regarding cultural resources and carrying capacity.
- How can ASMIS be augmented to be more applicable to VERP monitoring efforts?
- Explore the possibility of expanding cultural resources indicators that address human impacts to historic structures and landscape resources.

Finally, the workshop participants identified a series of broad objectives to achieve in the coming year:

- Finalize and peer review monitoring protocols.
- Develop visitor survey plan. When? How often?
- Continue application of VERP process in Tuolumne.
- Continue implementation of Soundscape indicator.
- Establish range of acceptable standards of quality.
- Conduct literature review on research related to visitor use impacts and cultural resources.
- Explore how to use existing databases and related information more effectively without additional work for the staff.

The remainder of the workshop was spent in individual workgroups organized by indicator variable. These workgroups began by filling out a detailed evaluation form that addressed such issues as: indicator performance, indicator successes and challenges, suggestions for improvement, standards of quality, and other information.

Figure 3.2.2. A work group discusses monitoring protocol refinements.

4. SUMMARY

The data and information presented in this report is intended to inform planning and management decisions regarding visitor use and its impact to the Merced River's Outstandingly Remarkable Values within Yosemite National Park. This report has provided a descriptive presentation of results. Though still a young program, measuring and monitoring indicator variables has already provided park planners and managers with valuable scientific data and information to inform their decision making. The utility of this data and information, however, is not limited to the analyses reported here. Rather, additional analysis and synthesis of the data may be conducted in the future to verify results, test additional hypotheses, and otherwise further inform planning and management efforts on a continual basis. The VERP monitoring program is an integral component of a broader adaptive visitor use management process. It is intended to evolve over time as new information, technologies, and methods are made available. This report helps to build the institutional memory that ensures this process continues.

Lastly, park managers have a variety of tools available to them to address visitor use and its impact to the park. Results contained in this report will provide important information to help managers select the best tools to affect desired outcomes. This "informed management action" closes the loop of the VERP framework and the process continues.

APPENDICES

APPENDIX A: REFERENCES

INTRODUCTION

Hof, M. and D. Lime (1997) *Visitor Experience and Resource Protection Framework in the National Park System: Rationale, Current Status, and Future Direction.* In: McCool, S., Cole, D. (comps.) 1997. Proceedings – Limits of Acceptable Change and related planning processes: progress and future directions. May 20-22: Missoula Mt. Gen. Tech. Rep. INT-GTR-371. Ogden, UT: USDA, Forest Service, rocky Mountain Research Station.

Hof, M., Hammitt, J., Rees, M., Belnap, J., Poe, N., Lime, D. & Manning, R. (1994) *Getting a Handle on Carrying Capacity: A Pilot Project at Arches National Park*. Park Science, 14(1): 11-13.

Manning, R. (1999) *Studies In Outdoor Recreation.* Corvallis: Oregon State University Press.

National Park Service (1995) *The Visitor Experience and Resource Protection Implementation Plan: Arches National Park*. Denver: Denver Service Center.

National Park Service (1997) *Visitor Experience and Resource Protection (VERP) Framework: A Handbook for Planners and Managers.* CO: Denver Service Center.

National Parks and Recreation Act (1978) *Public Law 95-625 U.S.C.*

Organic Act (1916) *Public Law 16 U.S.C. 1*

Wild and Scenic Rivers Act (1968) *Public Law 90-542; 16 U.S.C. 1271-1287.*

YOSE (2004) *User Capacity Management Program for the Merced Wild and Scenic River.* US Department of the Interior, National Park Service. Yosemite, CA.

YOSE (2004) *VERP Field Monitoring Guide.* US Department of the Interior, National Park Service. Yosemite, CA.

YOSE (2005) *VERP Annual Report.* US Department of the Interior, National Park Service. Yosemite, CA.

YOSE (2005) *VERP Field Monitoring Guide.* US Department of the Interior, National Park Service. Yosemite, CA.

MONITORING RESULTS

Water Quality

State of California, (1998) The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region. Fourth Edition — 1998. California Regional Water Quality Control Board.

Standard Methods for the Examination of Water and Wastewater (2005). 21st Edition - American Public Health Association (APHA), American Water Works Association (AWWA) & Water Environment Federation (WEF).

State of California, California Code Of Regulations Title 22. Social Security Division 4. Environmental Health Chapter 15. Domestic Water Quality And Monitoring Regulations Article 4. Primary Standards -Inorganic Chemicals s 64431. Maximum Contaminant Levels -Inorganic Chemicals. s 64431.

Number of Social Trails

Manning, R., Vallier, W., Lawson, S., Newman, P., Budruk, M., Laven, D., Bacon, J., and Wang, B. (2005) *Development and Application of Carrying Capacity Frameworks for Parks and Protected Areas.* In: Global Challenges of Parks and Protected Area Management. (Ed.) Camarda, I., Manfredo, M., Mulas, F. & T. Teel. Proceedings of the 9th International Symposium on Society and Resource Management, Oct. 10-13, 2002: La Maddalena, Sardinia, Italy.

Marion, J. and Y. Leung (2004) *Environmentally Sustainable Trail Management.* In: Environmental Impacts of Ecotourism, ed. R. Buckley.

Mitsch, W. J. and J.G. Gosselink. (2000). *Wetlands: Third Edition*. John Wiley and Sons, Inc. New York, New York.

Length of Social Trails

Holmquist, J. and J. Schmidt-Gengenbach. (2003). Do Trails Fragment meadows more than we think? A bug's view. Sierra Nature Notes, 3.

Manning, R., Vallier, W., Lawson, S., Newman, P., Budruk, M., Laven, D., Bacon, J., and Wang, B. (2005) *Development and Application of Carrying Capacity Frameworks for Parks and Protected Areas.* In: Global Challenges of Parks and Protected Area Management. (Ed.) Camarda, I., Manfredo, M., Mulas, F. & T. Teel. Proceedings of the 9th International Symposium on Society and Resource Management, Oct. 10-13, 2002: La Maddalena, Sardinia, Italy.

Wildlife Exposure to Human Food

Decker, D., Brown, T., Connelly, N., Enck, J., Pomerantz, G., Purdy, K., and Seimer, W. (1992) *Toward a Comprehensive Paradigm of Wildlife Management: Integrating the Human and Biological Dimensions.* In: American Fish and Wildlife Policy: the Human Dimension, ed. W. R. Mangun, 33-54. Carbondale, IL: Southern Illinois University Press.

Manfredo, M., Vaske, J., and Decker, D. (1995) *Human Dimensions of Wildlife Management: Basic Concepts.* In: Wildlife and Recreationists: Coexistence Through Management and Research, ed. R. L. Knight and K. J. Gutzwiller, 17-31. Washington, DC: Island Press.

Ethnobotany

Balick, A. (1996) Plants, People, and Culture: The Science of Ethnobotany. *Scientific American Library*, New York, USA.

Cotton, C. (1996) Ethnobotany: Principles and Applications. *John Wiley and Sons, Inc.* Chichester, UK.

Elzinga, C.L., D. W. Salzer, and J. W. Willoughby. (1998). *Measuring and Monitoring Plant Populations*. BLM Technical Reference 1730-1. Bureau of Land Management, Denver, Colorado.

Pieroni, A. (2006) *Journal of Ethnobiology and Ethnomedicine: Achievements and Perspectives.* Journal of Ethnobiology and Ethnomedicine, 2:10.

Ruppert, D.E. (2001). *New Tribe/Park Partnerships*. Journal of Cultural Resource Management, National Park Service. Volume 24, Number 5.

Wilderness Encounters

Lucas, R. (1964) *Wilderness Perception and Use: The Example of the Boundary Waters Canoe Area.* Natural Resources Journal. 3, 394-411.

Patterson, M. and Hammitt, W. (1990) *Backcountry Encounter Norms, Actual Reported Encounters and Their Relationship to Wilderness Solitude.* Journal of Leisure Research. 22 (3), 259-275.

Vaske, J., Graefe, A., Shelby, B. and Heberlein, T. (1986) *Backcountry Encounter Norms: Theory, Method and Empirical Evidence.* Journal of Leisure Research. 18 (3), 137-153.

West, P. (1982) *Effects of User Behavior on the Perception of Crowding in Backcountry Forest Recreation.* Forest Science. 28 (1), 95-105.

Newman, P. (2002) Integrating Social, Ecological and Managerial Indicators of Quality into Carrying Capacity Decision Making in Yosemite National Park Wilderness. Dissertation. University of Vermont, Burlington.

People At One Time (PAOT) along the River

Hammit, W. and D. Cole (1998) Wildland Recreation: Ecology and Management. *John Wiley and Sons, Inc.* New York, NY.

Manning, R., Lime, D., and Hof, M. (1996) *Social Carrying Capacity of Natural Areas: Theory and Application in the U.S. National Parks.* Natural Areas Journal, 16, 118-27.

Manning, R., Jacobi, C., Valliere, W., and Wang, B. (1998) *Standards of Quality in Parks and Recreation.* Parks and Recreation, 33, 88-94.

Manning, R.; Wang, B.; Valliere, W.; Lawson, S. (1998) Carrying Capacity Research for Yosemite Valley: Phase 1 Study. Unpublishe-d research report on file at Yosemite National Park, El Portal, CA

Manning, R.; Wang, B.; Valliere, W.; Lawson, S. (1999) Carrying Capacity Research for Yosemite Valley: Phase 2 Study. Unpublished research report on file at Yosemite National Park, El Portal, CA

Manning, R. (1999) *Studies In Outdoor Recreation.* Corvallis: Oregon State University Press.

Newman, P. (2002) Integrating Social, Ecological and Managerial Indicators of Quality into Carrying Capacity Decision Making in Yosemite National Park Wilderness. Dissertation. University of Vermont, Burlington.

Newman, P. (2005) Informing Carrying Capacity Decision Making in Yosemite National Park, USA Using Stated Choice Modeling. Journal of Parks and Recreation Administration. v.23 (1), pp.75-89

Parking Availability

Mings, R. and McHugh, K. (1992) *The Spatial configuration of Travel to Yellowstone National Park.* Journal of Travel Research. Spring. 38.

Nelson, B. and Tumlin, J. (2000) *Yosemite regional Transportation Strategy,* Transportation Research Record: Journal of the Transportation Research Board. V.1735, pp.70-78.

Percival, K. (1999) *National Parks and the Auto: A Historical Overview.* Paper presented at the National Parks: Transportation Alternatives and Advanced Technology for the 21st Century, Big Sky, MT.

Sims, C., Hodges, D., Fly, J., and Stephens, B. (2005) *Modeling Acceptance of a Shuttle System in the Great Smoky Mountains National Park.* Journal of Park and Recreation Administration. 23(3), 25-44,

Valliere, W., Manning, R., Lawson, S., Bacon, J., and Laven, D. (2003) *Standards of quality for Traffic Congestion in Parks: An Empirical Study of the Blue Ridge Parkway.* In: Proceedings of the 2003 Northeastern Recreation Research Symposium. GTR-NE-317. USDA Forest Service.

White, D., Youngs, Y., Wodrich, J. and Borcherding, T. (2006) *Visitor Experiences and Transportation Systems in Yosemite National Park.* Draft Technical Report. USDI National Park Service, Yosemite National Park, CA.

YOSE (1999) *Visitor Use Study.* Technical Report prepared by ORCA Consulting. USDI National Park Service, Yosemite National Park, CA.

YOSE (2000) *Yosemite Valley Plan.* USDI National Park Service. Yosemite National Park, CA.

Facilities Availability

YOSE (1999) *Yosemite National Park Visitor Use Study.* Prepared by ORCA Consulting for the National Park Service.

PROGRAM EVALUATION

Guadagnolo, F. (1985) *The Importance-Performance Analysis: An evaluation and marketing tool.* Journal of Park and Recreation Administration, 2, 13-22.

Martilla, J. and J. James (1977) *Importance-Performance Analysis.* Journal of Marketing, January, 77-79.

National Park Service (1997) *Visitor Experience and Resource Protection (VERP) Framework: A Handbook for Planners and Managers.* CO: Denver Service Center.

APPENDIX B: LIST OF ACRONYMS

ANOVA	Analysis of Variance
ASMIS	Archeological Sites Management Information Systems
BPLD	Bear Patrol Log Database
°C	Degrees Centigrade.
CMP	(Merced Wild and Scenic River) Comprehensive Management Plan
DO	Dissolved Oxygen
DOQs	Digital Orthophotos
GIS	Geographic Information System
GPS	Global Positioning System
ft.	Foot
HBMP	Human-Bear Management Program
km	Kilometer
l	Liter
m	Meter
MDL	Method Detection Limit
mg/l	Milligram per Liter
ml	Milliliter
mm	Millimeter
MLRS	Merced Lake Ranger Station
MPN	Most Probable Number (of bacterial colonies)
NO3 + NO2	Nitrate plus Nitrite
NPS	National Park Service
NWQL	National Water Quality Laboratory
PDA	Personal Data Assistant
PAOT	People at one time
pH	Potential Hydrogen
SOP	Standard Operating Procedure
TDN	Total Dissolved Nitrogen
TDP	Total Dissolved Phosphorous
TP	Total Phosphorous
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
µS/cm	Micro-Siemens (a measure of electrical conductivity)
VERP	Visitor Experience and Resource Protection
VOG	Vehicles On the Ground
WIMS	Wilderness Impacts Monitoring System

APPENDIX C: LIST OF PREPARERS AND CONTRIBUTORS

PREPARERS

- Jim Bacon, VERP Monitoring Program Coordinator, Resources Management and Science, Yosemite National Park
- Sue Clark, Special Park Uses, Business and Revenue Management, Yosemite National Park
- Crystal Elliot, Biological Science Technician, Vegetation and Ecological Restoration, Resources Management and Science, Yosemite National Park
- Mark Fincher, Wilderness Specialist, Yosemite National Park
- Dr. Yu-Fai Leung, Recreation Ecologist, College of Natural Resources, Parks, Recreation and Tourism Management , North Carolina State University
- Allison Lucas, VERP Monitoring Program Assistant, Integrated Resources Analysis Branch, Resources Management and Science, Yosemite National Park
- Bret Meldrum, VERP Monitoring Program Assistant Coordinator, Resources Management and Science, Yosemite National Park
- Joe Meyer, Branch Chief, Physical Science and GIS, Resources Management and Science, Yosemite National Park
- Dr. Peter Newman, Social Scientist, Department of Natural Resource Recreation and Tourism, Colorado State University
- Dr. Niki Stephanie Nicholas, Chief, Resources Management and Science, Yosemite National Park
- Jim Roche, Hydrologist, Physical Science and GIS, Resources Management and Science, Yosemite National Park
- Victoria Seher, Wildlife Biologist, Wildlife Management, Resources Management and Science, Yosemite National Park
- Judi Weaser, Branch Chief, Vegetation and Ecological Restoration, Resources Management and Science, Yosemite National Park